

IBM

Field Engineering

Preliminary

Maintenance Manual

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Disk Storage



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Field Engineering Maintenance Manual

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Disk Storage

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SAFETY

Personal safety cannot be overemphasized. To ensure your own safety, make it an every day practice to follow safety precautions at all times. Become familiar with and use the safety practices outlined in IBM pocket-size cards, Forms 124-0002 and M04-8401, issued to all Customer Engineers.

Use caution when working around moving parts of the machine. Parts of the body or clothing near the machine can cause accidents if the machine starts unexpectedly. These accidents can be prevented.

Potential difference within the power contactor box is -48vdc to 208vac. Potential difference within the electronic gates, printed cards, and display back panel is -48vdc to +36vdc. Do not remove or replace circuit cards when dc power is on.

The access cover door safety interlock switch must be bypassed for some servicing procedures (e.g., recovery of data using the tool drawer). Use extreme caution when this is done because the actuator can move if d.c. is dropped.

Wear safety glasses when performing any work that could possible result in parts, lubricants, cleaning solvents, or any materials coming in contact with the eyes.

Access Mechanism

Because of the random and sometimes unpredictable motion of the access mechanism, it should be serviced with caution. Shields and guards have been provided and can only be of assistance when firmly in place.

Care should be taken to remove the access assembly according to outlined procedures. Two men must be available to handle this unit as it weighs approximately 60 pounds and the mounting screws are accessible only from the rear of the supporting strut.

Any time maintenance is to be performed around an actuator with power on, the access mechanism must be set INOP and the safety circuits which hold the actuator output shaft detented (while the access cover door is removed) must be checked at least once for correct operation before proceeding.

Power Supplies

When a DC failure is sensed, a DC off sequence is initiated, but power remains on at the gate blowers, convenience outlets, and disk drive motor. Do not depend on this feature as safety protection.

Always use fuse pullers to remove or insert fuses. Replace plastic protective covers over fuses immediately after replacing fuse.

The power supplies are heavy and should be removed with care. Remove line cord from power receptacle and wait at least 15 seconds after power is turned off before attempting any repair or adjustment within any power supply.

Isopropyl Alcohol

The 91% isopropyl alcohol used to clean 1302 Read/Write heads is a flammable liquid. Therefore, keep only the quantity needed for impending use in the customer's office.

Keep the glass bottle containing the isopropyl alcohol in the sealed metal container except when in use. Replace the glass bottle in the metal container and reseal the lid whenever it is stored between usages.

Comply with appropriate regulations for flammable liquids when shipping 91% isopropyl alcohol.

High Voltages

High voltage lines and connections exist in many areas within the machine. Such voltages are found on transformers, terminals, convenience outlets, and the like. Contactor relays utilize high voltages at their points. Check these contactor relays with the power on only if absolutely necessary and with extreme caution.

Power On States

Before the file is brought up to running condition from the power sequence panel, it may exist in one of several states of power on. In all cases, the following assumptions are made:

1. The file is plugged into the wall.
2. The wall plug is at the specified potential.
3. An external source of 24vac is applied to the file (Emergency OFF : Power).

Mainline (70 amp C.B.) switch OFF.

1. 208-230 vac is present at:
 - a. Input and output of mainline filter.
 - b. Input to the mainline switch.
2. 24 vac is present at the coil of K-1.

Mainline switch and CB-2 (30 amp C.B.) ON.

1. 208-230vac is present at:

- a. Input and output of mainline filter.
 - b. Input and output of mainline switch.
 - c. Input and output of CB-2 and K-1.
 - d. Input to K-2, K-3, K-4, T1.
2. 110vac is present at:
 - a. Convenience outlet.
 - b. TB204, TB203, T1.
3. 24vac is present at:
 - a. Coil of K-1.
 - b. TB204, T1.
 - c. Power sequence panel.

When working in these areas, remove the input power cord or turn off AC power at customer's wall switch.

Grounding

Convenience outlets for Customer Engineers are provided on all machines. Convenience outlets for customer requirements may be provided as desired; however, the following grounding requirements should be noted.

Machine grounding is required. Four-wire grounded power cords are provided. The fourth wire is for grounding and must not carry current from any source except the radio interference filter.

It is important to the safety of personnel that if any machine of a group is grounded, all other equipment of the group must be grounded. Grounded machines must not be placed so that it is possible for a person to touch both a grounded machine and any ungrounded metal equipment. Grounded machines do not present a hazard in themselves; the real hazard is from ungrounded electrical equipment.

NOTE: The word CAUTION is used in this manual to indicate procedures that require extra precautions to ensure personal safety.

WARNINGS

Servicing

Any +S signal level may be grounded during trouble analysis unless that level is at the output of an emitter follower (DE card). If a DE output is tied to +S, the +S will be transmitted to the DE input line and represent a damaging short on the transistor driving the DE.

Use caution when installing or removing plastic covers over terminal blocks. Since the cover mounting springs are easily bent, they could touch a terminal thereby shorting the terminal to the frame. Avoid operating the file for prolonged periods of time with the SMS card covers removed.

Receiver

Any time the receiver is swung out, drawers and heads are in an extremely vulnerable position. DO not leave the receiver unattended while in this position.

Electrical arcing between the head and disk can occur if a voltage of about 25 volts is applied between the isolated receiver and frame ground.

Disk Array

If any of the disk-array shields are removed, the disks must be cleaned and the disk array must be purged after the shields are reinstalled. If the access cover or the access-cover door is removed, warm up stabilization is necessary (see Section 3.0).

Never run the disk array with shields removed.

Never leave the covers off the disk array except when necessary for servicing.

The access-cover door in the access cover may be opened any time the actuator is not in motion without stopping the array, but care should be taken to keep out dirt and dust.

DO not run the array if the disk-array filter is not securely in place. Head and disk damage may result.

ALways handle the disks with nylon gloves to prevent fingerprints on the disks.

Read/Write Heads

Never load the heads when they are out of the disk array.

Use only 91% isopropyl alcohol (P/N 2155966) to clean heads and disks.

Do not put scope probes, leads, or jumpers of any kind on the lines coming directly from the data or format heads. The heads can be damaged and/or data destroyed by possible potential differences.

Hydraulic Actuator

The actuator housing can be damaged in the area where the housing is positioned against the radial locating key if excessive torque is applied to the radial positioning screw. To eliminate the possibility of damaging the actuator housing, the radial positioning screw should be torqued to a setting of 12" lbs at the wrench dial, when using the torque wrench and adapter. Exercise caution to assure that the wrench is used in the direction which "snaps" to indicate proper torque (wrench is solid in opposite direction).

Index Transducers

Adjust the index transducers carefully, as there is a possibility of the index slug contacting the transducer pole tip and breaking off the slug.

Inop Switch

Data may be destroyed if this switch is operated when the system is not halted.

Head Arcing

To avoid head to disk arcing, the following precautions must be observed:

1. Do not remove receiver cables with heads loaded.
2. Do not turn power on unless ac and dc grounds are connected together (in the system).

NOTE: The word WARNING is used in this manual to indicate procedures that require extra precautions to prevent machine damage and/or malfunction.

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1.1 INSTALLATION INSTRUCTIONS

1. Remove packing material as specified in unpacking instructions.
Do not install drawers.
2. Inspect machine for shipping damage, especially in the power
contactor box, hydraulic power supply, and SMS gates.

WARNING: Applying power to machine with loose or damaged connections
in these areas can cause damage to the machine and its surrounding
area.

3. Check input voltage. The 1302 is factory wired for 208vac
input. If 230vac Operation is desired, complete the following:
 - a. Remove cable wire from Bulk transformer terminal 4 and
install on terminal 5.
 - b. Remove cable wire from service transformer (T1) terminal
2 and connect to terminal 3.
 - c. Remove cable wire from TB300-4 and connect to TB300-5.
4. Before securing electronic frame to mechanical frame, connect
all power cables from mechanical frame to electronic frame.
Level electronic frame with mechanical frame. Verfiy that
frame-grounding washers are secured between frames.
5. It is necessary to rearrange some of the components in the
I/O area depending upon whether the file is the last one (or
only one) of a series of files or if it is not the last one.
 - a. LAst File, or only one: The End-of-Line Terminators
(TCK-P/C 3700334) should be placed in B01, B03, B05,
B07, C03, and C05.
 - b. Not Last File: The End-of-Line Terminators should be
placed in B01 and B07.
6. Swing out the receiver (see Receiver Swing Out, Section 3.2).
7. Clean the disks (refer to Disk Cleaning, Section 3.1.4).

8. As the drawers are installed (see Drawer Replacement, Section 3.2.2), inspect the drawer and clean the heads. These units are adjusted at the plant and are not interchangeable. When the 1302 is shipped from the plant the drawers are removed and stored in a definite sequence in a separate shipping container. A Log of the drawer sequence by module is sent along with the 1302. It is important that the drawers are installed in the 1302 in this same sequence.

WARNING: Never load or unload the heads when they are out of the array.

9. Swing receiver into the array (see Receiver Swing In, Section 3.2). Check for binds in loading mechanism.

NOTE: It is not necessary to manually load and unload heads to ensure correct alignment on the 1302.

10. Push access fully into disk array against inner limit stop.
11. Check that the carriage way wipers are not dry and that the way is not dirty.
12. Replace access cover.
13. Before applying power, check that the voltage at customer's outlet agrees with that shown on the 1302 nameplate.
14. Set sequence control switches to Local-Manual control then start disk drive motor and check disk rotation as indicated by arrow on filter frame. Turn on electronic DC, solenoid DC, and hydraulic power supply.

WARNING: Do not load the heads.

15. Inspect drawer profiles. (See Figure 3-17.)
16. Allow the disk array to run (see Purging Section 3.1) for 1-1/2 hours before loading heads.
17. Load heads for 30 minutes.
18. Unload heads and turn machine off. Check run-down time of disk array and compare it to the run-down time recorded on the decal in the power sequence gate. Run-down time should never be less than 60% of that recorded on the decal.
19. After the disks have come to a complete stop, remove the access cover and again inspect and clean heads and disks.
20. Swing in receiver.
21. Replace access cover.
22. Purge system for 15 minutes before loading heads.
23. Reinspect the heads and disks again at the end of the first, second, and third weeks of operation. After that time, refer to the scheduled Maintenance Routine Chart in Section 2 for correct inspection frequency.

1.2 MACHINE SPECIFICATIONS

Operating Environment

The 1302 will operate at ambient temperatures from +65°F. to 90°F. with humidity ranges of 10% relative to 80% relative.

A thermal switch and timer are provided which interlocks the 1302 to prevent file operation outside allowable temperature limits. The time required to "warm up" the 1302 depends upon the room temperature (Figure 1-1). The thermal switch must reach its set point (85° MOD II, 77° MOD I) and the timer must complete its cycle (30 Min) before file ready is on. At no time should the warm up period be less than 30 minutes.

Physical Characteristics

Size and weight specifications for the IBM 1302 D.S. are given in Figure 1-2.

Input Supply Voltages

The 1302 Disk Storage unit requires a 208/230 volt, 3 phase, 60 cycle input power source. The line to line voltage tolerances must be maintained within plus or minus 10% of the rated RMS voltage when the file is in operation. This tolerance includes any variable combination of steady state and/or transitions of greater than 0.5 seconds.

Bonding and grounding shall be such that the electrical resistance between the metallic frame or shell of any electrical chassis and the file frame, or components thereof, does not exceed 1.0 ohm when measured with an ohmmeter whose open circuit voltage does not exceed 1.5 dc.

The emergency off contactor shall be operable and shall break all incoming power to the machine including the 24vac and 110vac convenience circuits when the contactor is de-energized.

Stabilized Room Temperature in Degrees	Warm Up Time in Minutes
65	60
70	40
75	30
90	30

Figure 1-1 Warm Up Time Requirements

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	Model 1	Model 2
Size		
Length	86"	86"
Width	33"	33"
Height	68 5/8"	68 5/8"
Weight		
50" Frame	2825 lbs.	3175 lbs.
36" Frame	<u>1200 lbs.</u>	<u>1250 lbs.</u>
Total Weight	4025 lbs.	4425 lbs.

Figure 1-2 Physical Characteristics

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SECTION 2 SCHEDULED MAINTENANCE

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2.1 APPROACH TO SCHEDULED MAINTENANCE

The prime objective of any maintenance activity is to provide maximum machine availability to the customer. Every scheduled maintenance operation should assist in realizing this objective. Unless a scheduled maintenance operation decreases machine downtime, the operation is unnecessary.

Absolute cleanliness is essential to proper operation and maintenance of this machine. A vacuum cleaner should be used to ensure cleanliness of machine components and surrounding areas.

2.1.1 Visual Inspection

Visual inspection is the first step in every scheduled maintenance operation. Always look for corrosion, dirt, wear, cracks, binds, burned contacts, and loose connections and hardware. Alertness in noticing these items may save machine downtime at a later date.

2.2 SCHEDULED MAINTENANCE PROCEDURES

Specific items of scheduled maintenance are scheduled on punched cards processed in the Central Processing Unit for the branch office. Details of scheduled maintenance operations are listed in the Scheduled Maintenance Routine CHart (Figure 2-1). During normal scheduled maintenance, perform only those operations listed on the chart for that scheduled maintenance period. Details on adjustments, service checks, and removal and replacement are given in the Sections listed in the index column of the chart (Figure 2-1). OBserve all safety practices.

NOTE: The frequencies shown in this chart are for 176 hour months; adjust frequency for individual machines.

NOTE: Perform actuator and data head scheduled maintenance during warm-up with only one cover removed and receiver swung out.

	Unit or Routine	Freq. Mo.	Lubricate - Clean	Observe	Section
9	Actuator	2	Oil with eye dropper and IBM #6 Oil if required. See "Observe" column.	Check rear felt (Figure 2-2). If wet when eye dropper is pushed against it, do not oil. If dry, fill syringe to approximately 1.0"; add this amount of oil to each rear felt. Do not add oil to the front felt wipers.	
1	Data Head and Arm Assemblies	4	Remove any accumulated dirt from arm assembly. If required, clean heads with lint-free tissues and IBM Isopropyl Alcohol, using head cleaning paddle. Absolute cleanliness is essential.	Check all heads for smooth surface finish per CE Maintenance Manual Instructions. Check visually for relative alignment of heads and arms using the drawer alignment comb. Visually check receiver cables, clamps, braces, connectors, etc. for any looseness or fraying.	
9	Actuator	4	Do not use any solvent on any actuator moving parts. Wipe actuator ways with a clean lint-free tissue dampened with IBM #6. Leave a light film of oil on ways. Oil rear felt as directed at two month period. Wipe any excess oil from felt wiper housings and from actuator housing. Check oil absorption pads. If saturated, squeeze out excess oil or replace pad.	Check with dental mirror that felts are touching the ways. Check output shaft seal for leaks. If the seal is leaking replace the actuator.	
9	Air Compressor System		*Open valve on bottom of air tank to drain any accumulated moisture.	Check with heads loaded that system pressure is between 64 and 66 psi. Compressor should turn on no more than once every two hours. If frequency increases, check air system for leaks. Compressor should pump up system from 0 to 30 psi within 45 seconds.	
9	Hydraulic Power Supply	6	Change both paper filters. *Add oil to reservoir when oil level goes below sight gage. Always add one gallon from new containers. Check cooling coils for dirt and clean if required. Drain drip pan and wipe clean.	*Check system pressure 550 ±10 psi.	
1	Clock Head and mechanism	8		Inspect and clean using instructions for data head and arm.	
0	Blowers and Filters		*Lubricate the three blower bearing felts in each gate with IBM #6. Gate filters can be vacuum-clean rather than washed, however, washing is preferred and should be done when possible.	*Check SMS gate filters. If dirty, clean by flushing with hot water and shake dry. Check power supply blower filter and replace if required.	

Figure 2-1 Scheduled Maintenance Chart (Part 1 of 2)

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	Unit or Routine	Freq. Mo.	Lubricate - Clean	Observe	Section
9	Hydraulic Power Supply	6		Change hydraulic oil. Replace inner steel filter and return replaced filter to San Jose.	
0	Disk Array Filter	12	When filter is replaced clean thoroughly and purge as described in Section 3.1.	The disk array filter will normally last three years. However, adverse environmental conditions can cause it to become clogged. Replace it if it has over 1/4" dirt accumulation, or at the end of three years. Mark installation date on new filter.	
9	Shaft Motor			Check line cords for safe condition and ground-ind. Check disk run down time and compare it with run down time recorded on decal on power sequence gate door. Replace motor if run down time is less than 60% of original run down time. Always make this check at a time when you or the customer would be shutting down the disk array.	
0	Diagnostics Check			Run file diagnostic programs for each system	
9	Actuator		Replace felt wipers and oil absorption pads. Lubricate new felts, both front and rear, with IBM #6 as directed at two month period. Clean ways as directed at four month period.	Check that aluminum wiper holders do not touch housing ways. Oil front felts only when newly installed. At all other times oil rear felts only. Since new felts can increase drag, exercise actuator with Seek Repeat box for a short period of time after file ready.	
1	Head Load Mechanisms	14	Oil head load linkages with IBM #6. Oil sparingly. These links are not high speed and are seldom operated. If any of the head load time requirements are not met, the piston cylinder assembly should be checked for adequate lubrication and the mechanism checked for freedom of motion. When handling and assembling the assembly, extreme care must be exercised to keep it absolutely clean. Lubricate cylinder assembly as shown in Figure 2-3.	With working pressure at 64 - 66 psi, the total load time between the break of the heads unloaded switch and the make of the heads loaded switch must not exceed 120 ms. (Both head load mechanisms in a module are loaded simultaneously.) Total unload time between the break of the heads loaded switch and the make of the heads unloaded switch must not exceed 105ms.	
			*Do during warmup after head - actuator P.M.	*Do during warmup after head - actuator P.M.	

Figure 2-1 Scheduled Maintenance Chart (Part 2 of 2)

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2.2.1 Solid-State Circuits

Diagnostic programs and marginal checking are the basic tools used in scheduled maintenance of solid-state circuits. These items are excellent troubleshooting tools and are effective in locating potential and intermittent troubles. When using them for scheduled maintenance, use them only as directed on the scheduled maintenance chart. Diagnostic programs for the 1302 are available through the system to which the 1302 is attached.

Do not adjust pulses unless the condition of the machine warrants it.

2.2.2 Mechanical Units

Three basic scheduled maintenance steps that are performed on mechanical units are cleaning, lubrication, and inspection. Remember, do not do more than recommended scheduled maintenance on equipment that is operating satisfactorily. Figures 2-2, 2-3, and 2-4 are lubrication charts for the 1302 mechanical components.

2.3 ELECTRONIC SCHEDULED MAINTENANCE ROUTINE

2.3.1 Access Time

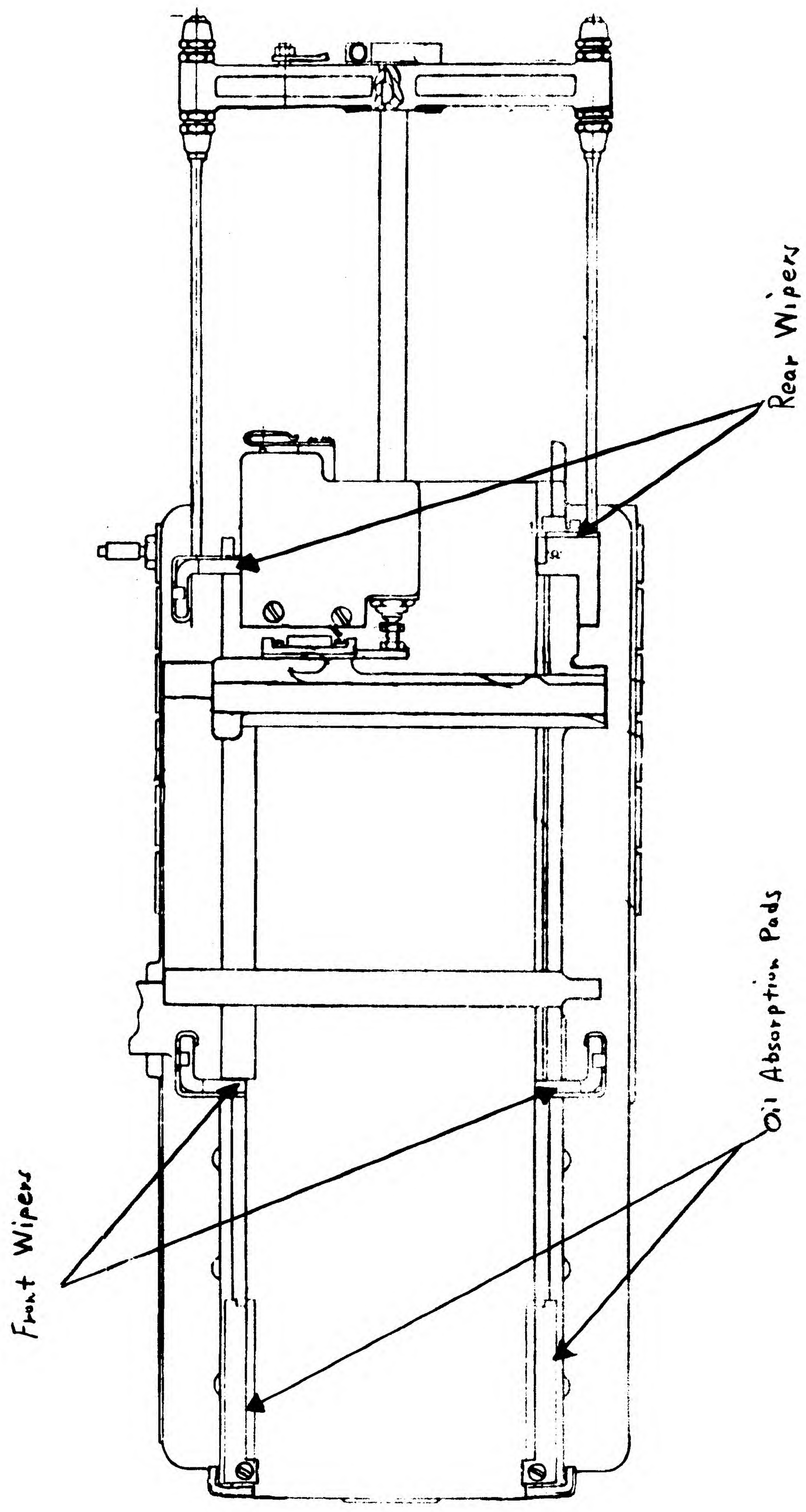
Adjustment

NOTE: All card and signal locations are given for M0A0. These card and signal locations can be converted to any other access by changing the first two characters (A6) to the following:

M0A1 - A4
M1V) - B6
M1A1 - B4

To accurately adjust or check access time, the motion oscillator must be in the fast state (oil temperature at thermal switch = 105°F. + - 3° F.

1. Adjust the single shot card (DHE-) output at A6C04P for a 4.0 millisecond (ms) minus pulse:
 - a. Set rezero.
 - b. Jumper A6F17C To A6C04L to provide an input signal to the single shot for this adjustment. The "L" pin on the card at A6C04L is an additional input that is not used, therefore, it is not shown in the system diagrams.
 - c. Remove jumper after adjustment of single shot.



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Figure 2-2 Carriage Wiper Location

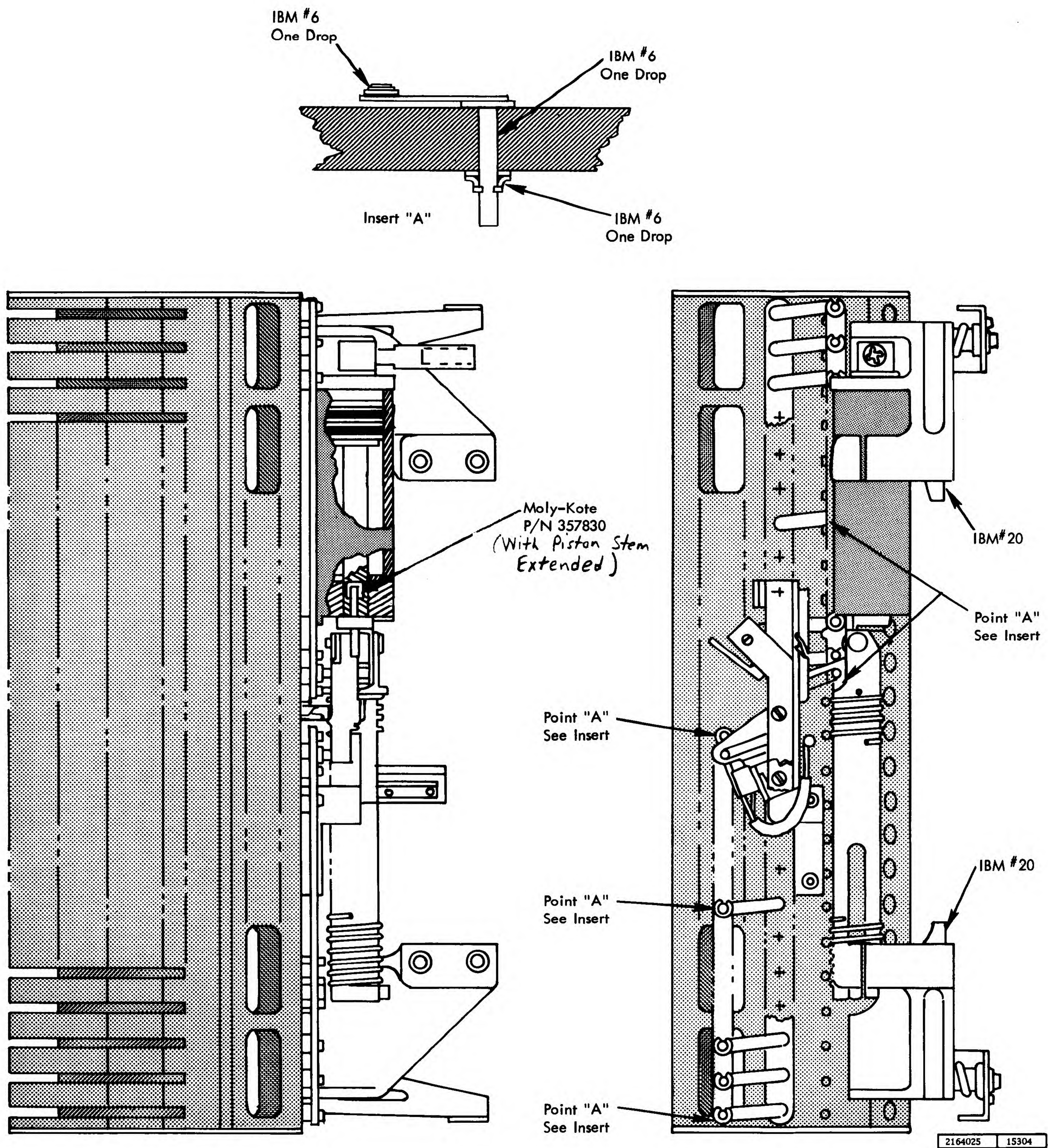


Figure 2-3 Receiver Lubrication Chart

2. Adjust oscillator at A6C06 to produce an access time for a short seek (1, 2, 4, Piston) of 50 ms (+0 ms -1 ms):
 - a. Set up a program loop (or REMote CE Box) to move the actuator 8 tracks and back.
 - b. Sync on the +S got-to-go signal at A6B25H and scope the access-ready signal at A6A16C.
 - c. ADjust oscillator at A6C06 until 50 ms (+0 ms -1 ms) is obtained from the got-to-go signal to the access-ready signal.
3. Check access time for the large piston (10 piston) for 120 +0 -3 m.s. Since the oscillator has been adjusted in Step 2, this time should be correct.
 - a. Set up a program loop (or Remote CE Box) to pick and drop the 10 piston only.
 - b. Sync on the +S got-to-go signal at A6B25H.
 - c. Scope the access-ready signal at A6A16C.
4. Check the access time of a long seek (40', 40", 100) for 180 plus 0 ms minus 2 ms:
 - a. Set up program loop (or Remote CE Box) to move the actuator 100 tracks and back.
 - b. Sync on +S glob-got-to-go signal at A6B21D.
 - c. Scope the access-ready signal at A6A16C.
 - d. Adjust single shot (A6C04) to get 180 ms (+0 ms -2 ms). Do not adjust the single shot pulse shorter than 2.0 ms or longer than 6.0 ms. To check single shot timing: with 100 loop servo running, sync minus on A6C04K and scope output of A6C04P. The minus output pulse must not be shorter than 2 ms nor longer than 6 ms.
5. Check the access time for the small globs (20 - 40) for 120 ms (+0 ms -2 ms).
 - a. Set up a program loop (or Remote CE Box) to pick and drop the 20 and 40 globs.
 - b. Sync on +S glob-got-to-go signal at A6B21D.
 - c. Scope the access-ready signal at A6A16C.
 - d. This time should be within the allowable tolerances. If it is not, the adjustment of the Single Shot in Step 4 may have to be compromised to satisfy both small and large glob seeks. However, do not adjust the single shot shorter the 2 ms or longer than 6 ms.

Service Check

When the oscillator is set within the fast range the slow frequency should fall between the limits shown.

2.3.2 Detent Safety Check

Detent safety check is an indication that the access has slowed enough to allow the detent to be inserted safely.

1. Check the air gap between the center pole of the transducer and the steel rack. It should be 0.007 ± 0.003 (this should be measured with a non metallic material). The gap at each end of the steel rack should be within .003 of each other.
2. Set address 100 into the register and set and reset the Register. The output of the transducer should be a minimum of 0.9 volts and a maximum of 1.6 volts.
3. Check the motion integrator (TED-at 01A5E 12). It should be adjusted to give maximum down level time as observed at Pin F while performing an access of 250 cylinders. This is to be measured during "B-C" portion of the motion cycle (See Figure 2-5).

2.3.3 Index Check -- 01.05.03.1

Check the time from leading edge of early index (01A5E07B) to leading edge of late index (01A5E07C). The time should be 475 ± 15 microseconds. If this time cannot be met by adjusting the late index circumferentially, then check motor speed for possible bearing trouble.

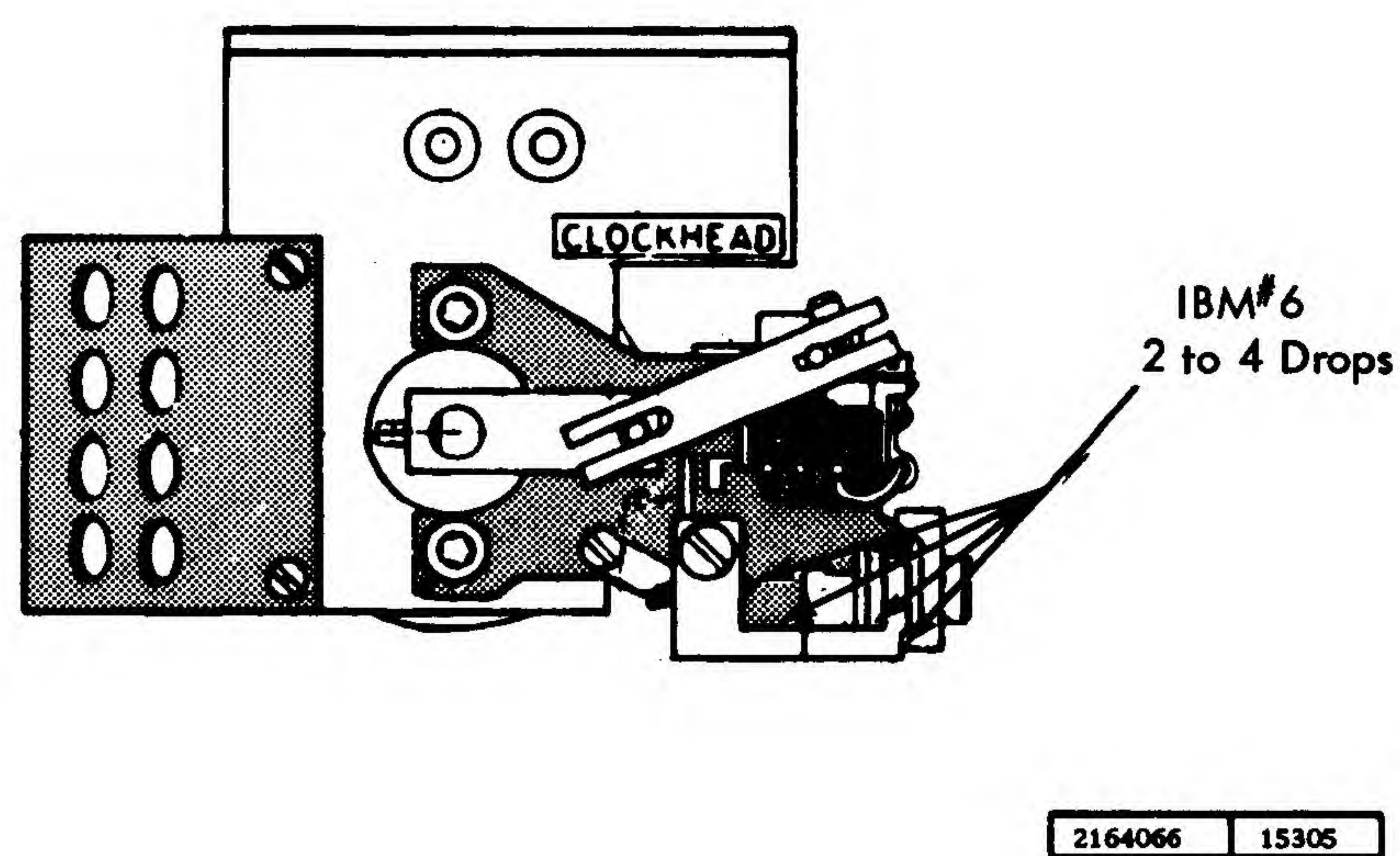
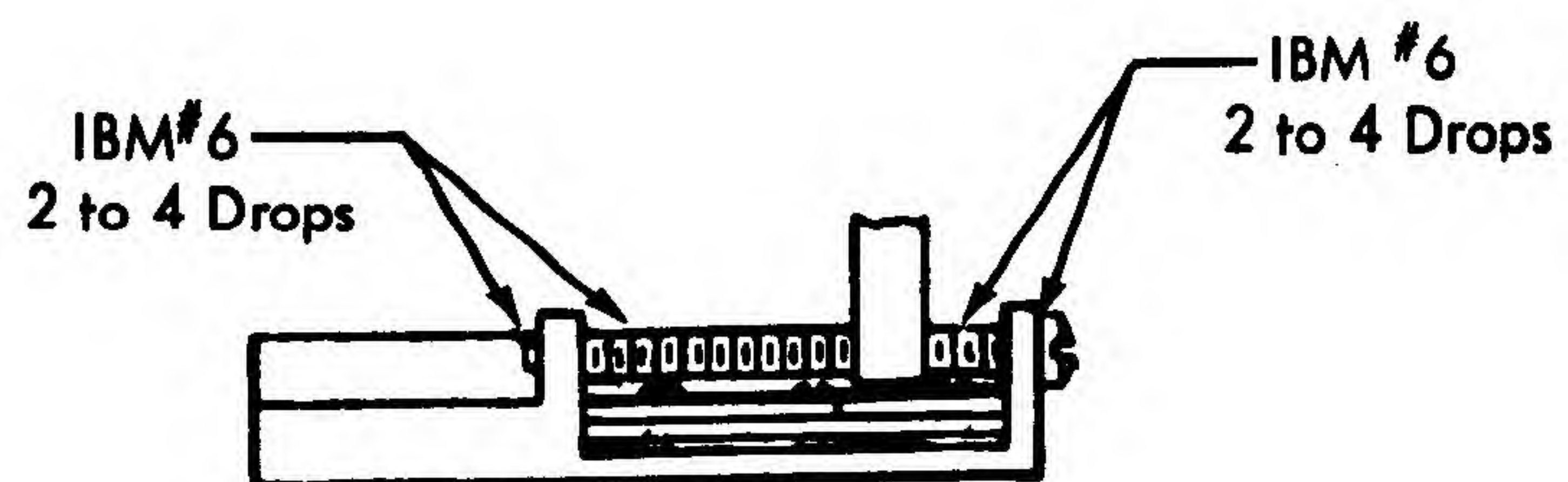


Figure 2-4 Clock Head Lubrication Chart

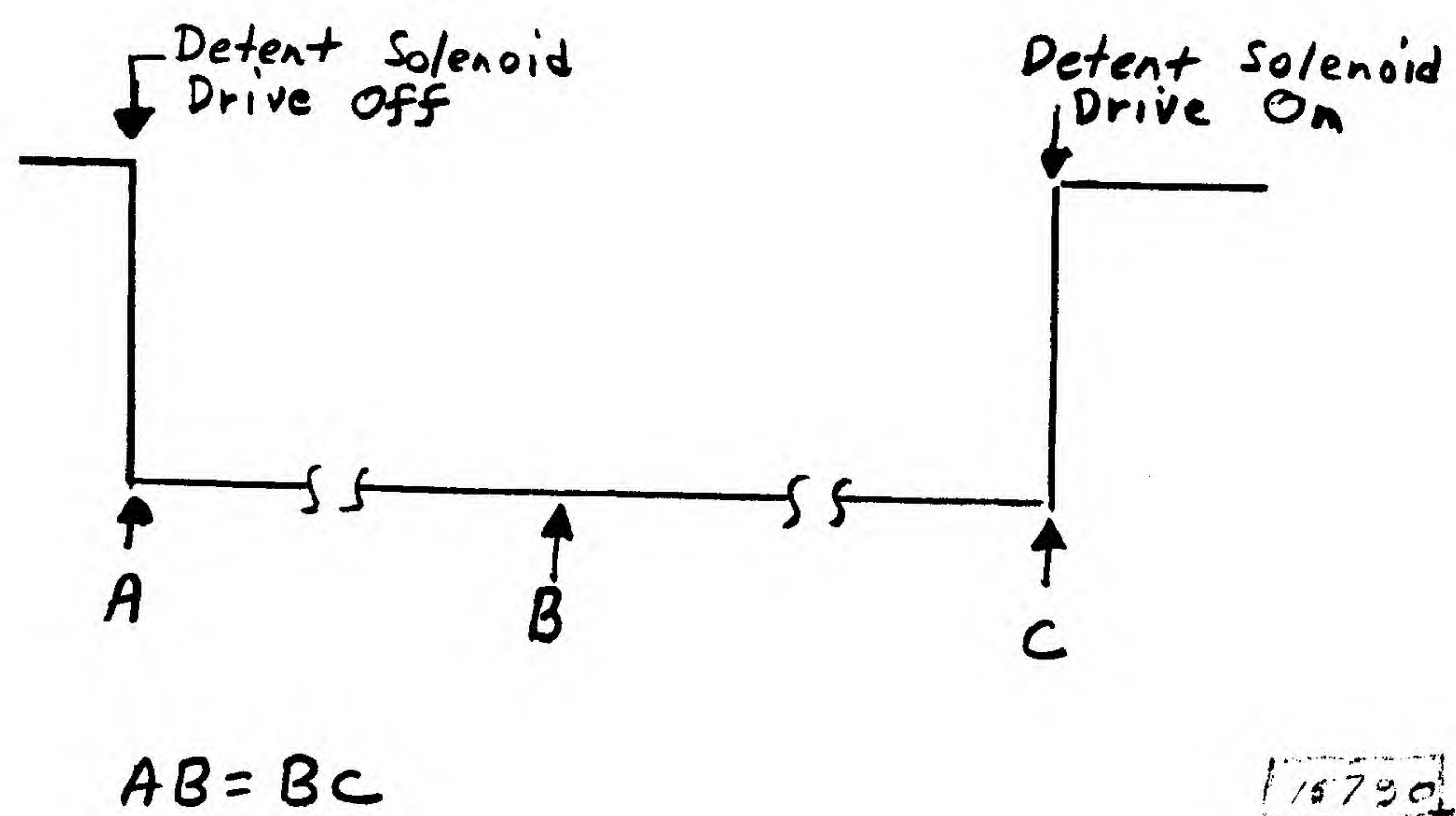


Figure 2-5 Detent Safety Check



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The receiver assembly cannot at any time be swung out of the disk array until all power has been removed from the File. However, once power has been removed and the disk array has started to coast down, it is permissible to swing out the receiver before waiting for the disk array to come to a complete stop. When the File is serviced in this manner and power is restored, a warm up period to set the thermal and timer will be necessary to bring "File Ready" up.

A Switch is provided which will bypass the warm up timer and permit operation of the File. However, it does not bypass the thermal switch and File READY WILL NOT BE UP unless the File is at the proper temperature. This switch should only be used for servicing and at no time should it be used to affectively reduce normal warm up time by consistently bypassing the timer control.

The access area can be serviced with power on, but off line from the system provided only one access door is off at any one time, and all accesses but the one being serviced must be at "000" position. If an access door is removed for any reason, a specific warm up period is required if the room ambient temperature is below 70°.

Door removed 0-5 minutes equals 20 minutes warm up.

Door removed 5 minutes or more equals 30 minutes warm up.

These warm up periods should be monitored by the person servicing the File and must be adhered to in order to safeguard File data.

3.1 DISK ARRAY

WARNING: If any of the disk array shields are removed, the disks must be cleaned and the disk array must be purged after the shields are reinstalled. If the access cover or the access cover door is removed, only purging is necessary. Never run the disk array with shields removed. Never leave the covers off the disk array except when necessary for servicing. The access cover door in the access cover may be opened any time the actuator is not in motion without stopping the array, but care should be taken to keep out dirt and dust.

Purging

Purging is the process of removing airborne foreign particles from the disk array chamber. These foreign particles are removed by running the array with the heads unloaded, thereby replacing the air in the pressurized chamber with filtered air for a prescribed interval of time. The benefit of purging may not be readily apparent, since there is no immediate measurable effect. However, failure to adhere to the process will invite damage to the disk surfaces. Purging is mandatory.

The purging process will not remove large particles. Therefore, it is essential to maintain extreme cleanliness when the pressurized chamber or its auxiliary areas are exposed to outside environments during servicing.

Purging is performed by placing the file in a "Local-Manual" mode and manually starting the disk drive motor only. After allowing the disk array chamber to be purged for the prescribed interval, manual sequencing operation may be resumed and the control switches restored to "Remote-Auto."

Purging, where possible can be done concurrent with file warm up time (Item 3).

3.1.1 DISK ARRAY FILTER

Removal

1. Remove AC and DC file power.
2. Remove the canopy over the disk array after it has been vacuumed to remove accumulated dust.
3. Remove filter by loosening the thumb screws and rotating the filter retaining hooks.
4. Lift filter off the filter holder surface, being careful not to allow any loose dirt to drop into the array.
5. Vacuum the machine area under the filter, being careful to vacuum all corners where particles may accumulate.

Replacement

1. Remove the replacement filter from the box and plastic bag in which it is shipped. Handle with care so filter will not be damaged in any way.
2. Check filter by holding it next to a strong light and looking through filter. If any tears or pin holes of light are seen, the filter must be replaced.
3. Place the filter in position with the gasket resting on the filter holder. Check that the filter seats all around the holder surface, then tighten the filter retaining hooks by hand as tightly as possible.
4. Run the array with the actuator at rezero and the heads unloaded for 45 minutes to purge the system and the new filter. Remove the filter after the array has stopped, revacuum as before and reassemble the filter to the machine.

WARNING: Do not run the array if the filter is not securely in place, as head and disk damage can result.

5. Remove actuator cover and clean disks by using the disk cleaning paddle covered with lint-free tissue. If dirt adheres to the disk surface, isopropyl alcohol must be used on the tissue (see Disk Cleaning).
6. Vacuum all areas and surfaces exposed by the actuator cover removal. Replace the actuator cover.
7. Purge array for 15 minutes before loading heads.

3.1.2 DISK ARRAY SHIELDS

3.1.2.1 Plastic Shields -- Front and Rear (Figure 3-1)

removal

1. Remove AC And DC power.
2. Vacuum false floor and all surfaces surrounding the shields.
3. Do not remove disk array shields until disks are completely stopped.
4. Remove access cover (see ACcess Cover).
5. Remove vertical trim (Figure 3-1).
6. LOosen the captive center screws and remove the shield.
7. Use a vacuum cleaner to remove any foreign particles from the surfaces and rubber seals exposed by the shield removal. Do not vacuum the disks.

Replacement (Figure 3-1)

1. Clean the plastic shield with isopropyl alcohol and lint-free tissue.
2. Secure the shield loosely with the captive center screw.
3. Install the left vertical trim (nearest the index shield) as far as possible toward the plastic shield and tighten trim holding screws.
4. Tighten the center captive screw.
5. Install access cover (see Access Cover).
6. Install and adjust the right vertical trim so that it retains the access cover securely but allows the access cover to be removed without loosening the trim holding screws. Also make certain that the vertical trim at the access cover side is positioned as far as possible away from the access port to allow clearance for swing out of the head assemblies. Tighten the trim holding screws.
7. Install sliding port door. Inspect clearance between inner edge of door and drawer assemblies, which should be a minimum of 1/8" and a maximum of 3/16". Bend stop on access shield if necessary to obtain this clearance.
8. Purge the array for 30 minutes.

3.1.2.2 Index Shield (Figure 3-1)

Removal

1. Remove AC And DC power.

2. Vacuum false floor and all surfaces around the shield.
3. Remove the two rearmost screws from the top and bottom of the front support casting and rotate casting 90° away from the disk array.
4. Remove vertical trim from each side of index shield.
5. Remove shield holding screws and shield. Do not remove the blue air duct from shield.
6. Use a vacuum cleaner to remove any foreign particles from the surfaces and rubber seals exposed by the shield removal. Do not vacuum the disks.

Replacement

WARNING: Back off transducers one revolution before installing index shield. This is to allow for any difference in compression of the rubber gasket around the disk array when the shield is replaced.

1. Replace index shield and secure with shield holding screws.
2. Place vertical trim as close as possible to plastic shield and secure in place.
3. ADjust transducers (see Index Heads Section 3.1.3).
4. Purge array for 30 minutes.

3.1.2.3 Access Port Shield (Figure 3-1)

Removal

1. Remove AC and DC power.
2. Vacuum false floor and all surfaces around the shield.
3. Swing out all receivers (see Receiver Swing Out Procedure).
4. Remove nylon door guides in from front.
5. Remove vertical trim from each side of shield.
6. Remove rear disk array shield.
7. Remove shield holding screws.
8. Lift shield approximately 1/4" and remove from rear of machine.
9. Vacuum all surfaces exposed by shield removal. Do not vacuum disks.

Replacement

1. Replace access port shield and secure with shield holding screws.
2. Install and adjust the vertical trim so that it retains the access cover securely but allows the access cover to be removed without loosening the trim holding screws. Tighten the trim holding screws.
3. Install nylon door guides to front side.
5. Swing in receiver (see Receiver Swing In Procedure).
5. Purge array for 30 minutes.

3.1.3 INDEX HEADS

Service Checks

1. The +S output pulse of the index amplifiers (TEB-01A5E07B and 01A5E07C) should be a minimum of 25 microseconds (Figure 3-2) and a maximum of 65 microseconds as measured at the -6 volt level.

If either output resembles Figure 3-3, check the respective index amplifier input for a minimum shift of 1.3 volts. If less than 1.3 volts, adjust the transducer air gap. If more than 1.3 volts, check amplifier for possible failure.

2. The time between the positive leading edges of the outputs at the early and late index amplifiers should be 475 microseconds, plus or minus 15 microseconds (Figure 3-4). Possible failure of the shaft motor is indicated if this timing is not within these limits.

Adjustment

Index-signal amplitude and width are adjusted simultaneously by moving the index transducer.

WARNING: Clockwise rotation of the index transducer must be done slowly and carefully as there is a possibility of serious damage to the machine if the index slug contacts the transducer pole tip. The gap between the transducer pole tip and the index slug should be $0.015" \pm 0.005"$.

1. Loosen jam nut on transducer.
 2. Adjust the gap between transducer pole tip and disk pole tip by rotating transducer until the required signal output is obtained (Figure 3-2). Adjustment of one-fourth turn moves the transducer approximately 0.015" in or out.
 - a. Counter-clockwise rotation of the index transducer decreases the index pulse width as well as the amplitude. A minimum amplitude of 1.3 volts must be maintained.
 - b. Clockwise rotation of the index transducer increases the index pulse width and amplitude. A minimum gap of 0.010" must be maintained.
 3. Lock transducer with jam nut.
- WARNING:** When tightening jam nut, make certain that transducer does not rotate inward. Do not push on shield while adjusting or locking transducer.

Replacement

1. Mount the index-head assembly to the index shield so that both transducer pole tips are in horizontal alignment with the index pole tip on the format disk within .020". Tighten nut to retain the index-head assembly.
2. Locate register plate relative to the bottom surface of the index-head assembly and tighten nut.
3. Adjust transducer.

3.1.4 DISKS

Cleaning

Anytime a disk array shield is removed, the disks must be cleaned. This cleaning is very important and must be done carefully as outlined below. Cleaning should only be done through the plastic shield area. Use only 91% isopropyl alcohol (P/N 2155966) for cleaning disks and heads.

CAUTION: Isopropyl alcohol and its vapors are flammable and must be kept away from open flames or lighted cigarettes.

1. Swing out receiver and secure with swing-out brace. If drawers have been removed, it is not necessary to swing out receiver; just return it to the outer limit stop.
2. Wrap the disk cleaning paddle (P/N 2108010) with an approved lint-free tissue dampened, not soaked, with isopropyl alcohol.

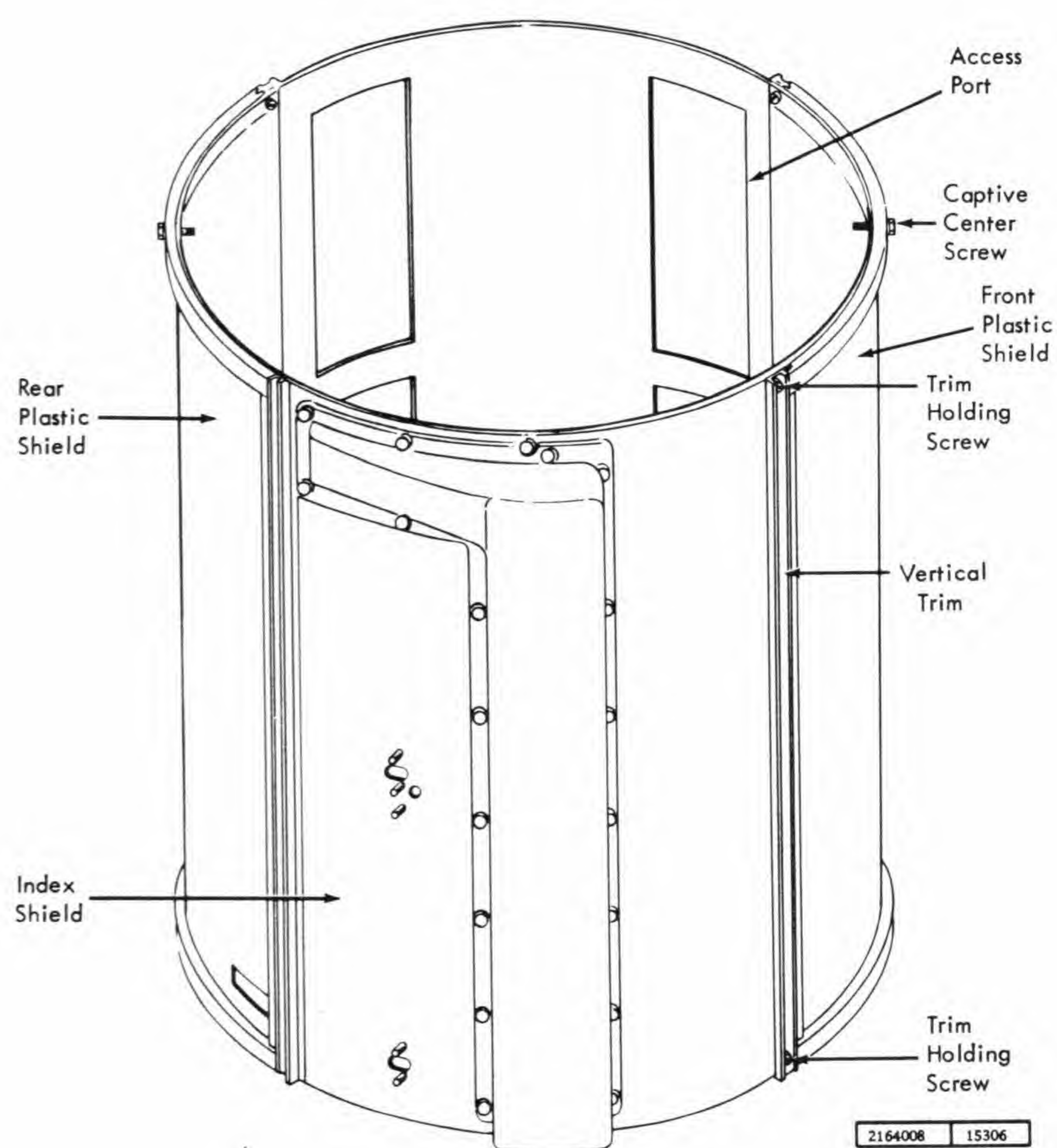


Figure 3-1 Disk Array Shields

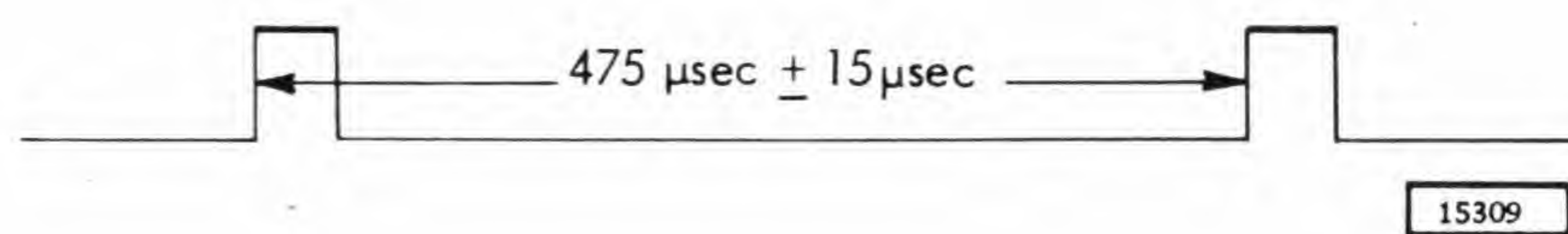


Figure 3-4 Early to Late Index Timing

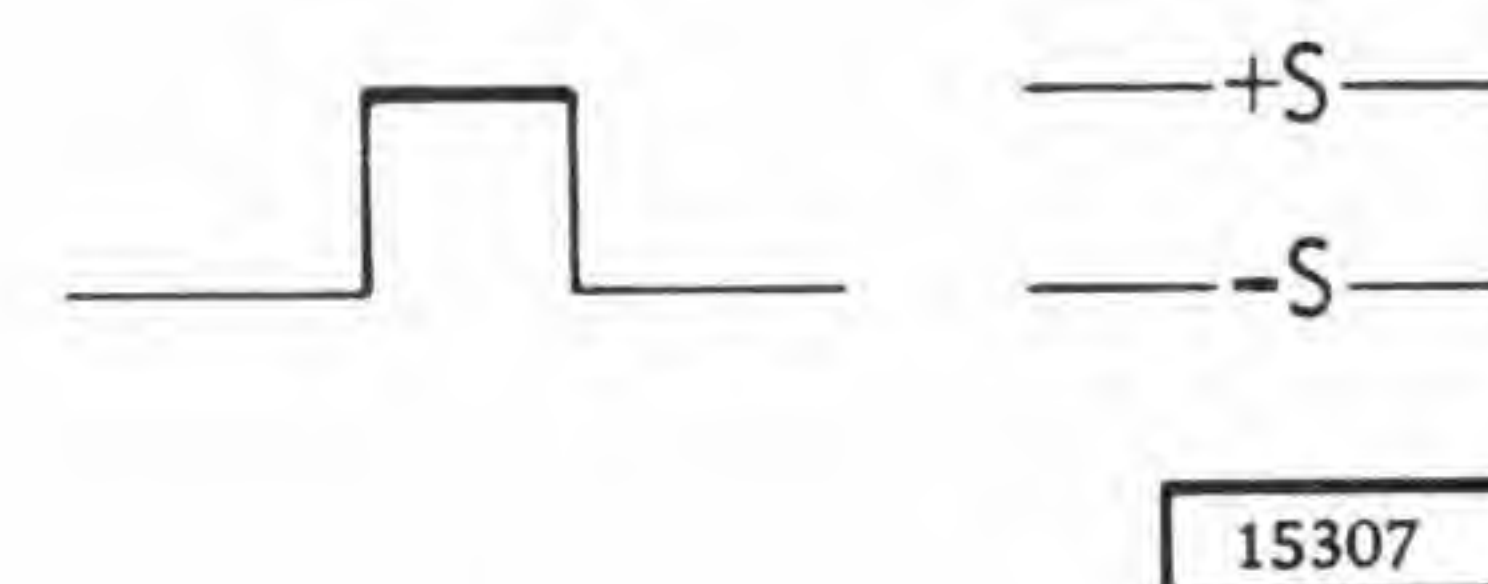


Figure 3-2 Correct Index Pulse

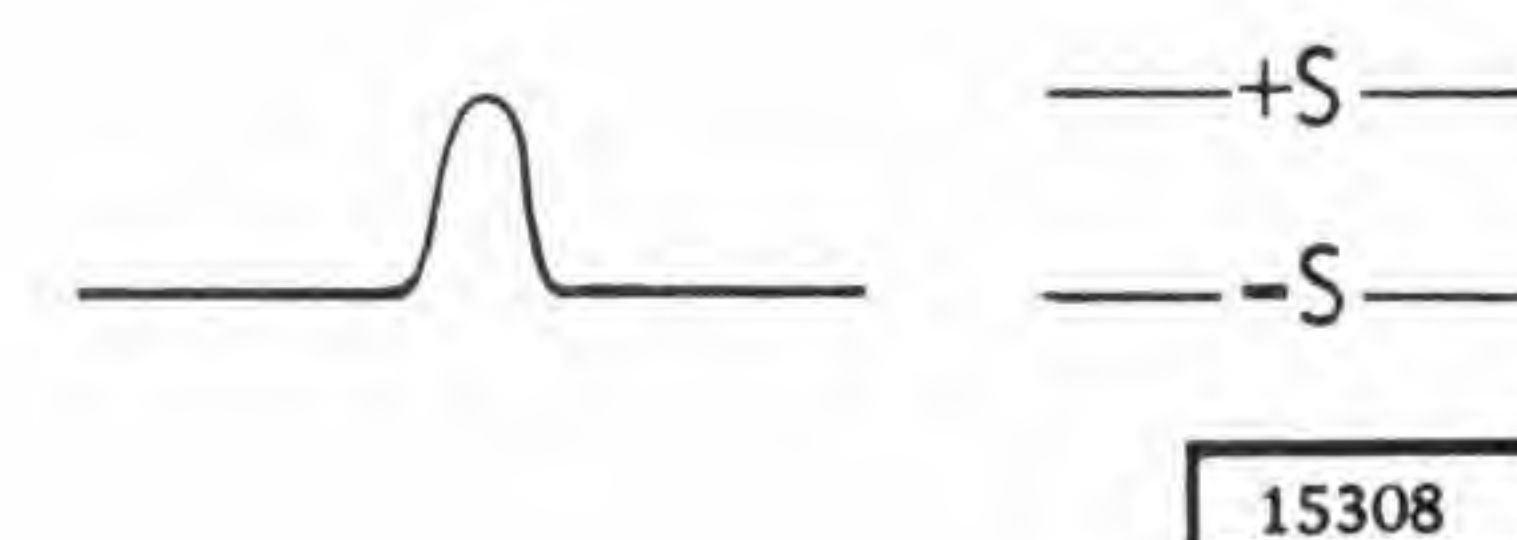


Figure 3-3 Incorrect Index Pulse

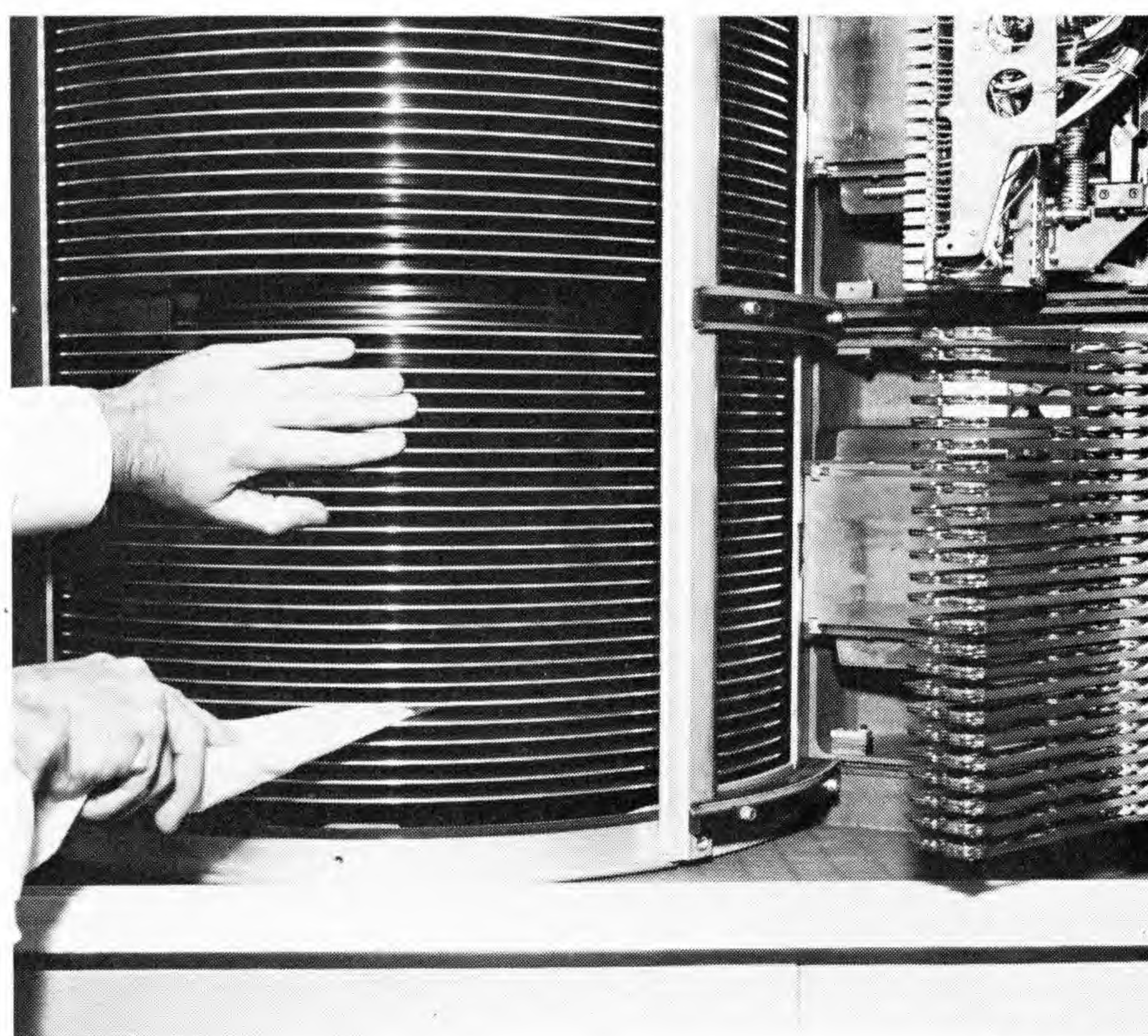


Figure 3-5 Cleaning Disks

A tissue that is soaked in alcohol can dissolve part of the dirt that is being removed and redeposit the dirt on the surface of the disk. However, a completely dry tissue should not be used either.

3. Place paddle between disks and rotate the disk array manually (Figure 3-5). If the surfaces of the disk are wet after cleaning, too much alcohol was used on the tissue, and the disks should be cleaned again properly.
4. Clean the disks until the contamination is removed. If the first tissue comes out dirty, reclean the disk. Use clean tissues for each surface of the disk.

When it is necessary to clean individual disks that are not in the file, place the disks on a flat cushioned surface (for example, a desk or table padded with several layers of lint-free tissue) to prevent scratching the recording surfaces of the disk.

1. Wipe the top surface of the disk with a tissue dampened with isopropyl alcohol. The surface of the disk should dry shortly after the tissue is removed. Use fresh tissues when the original tissue becomes dirty and for each new disk surface that is cleaned.
2. Turn the disk over and clean the bottom side.
3. Replace any disk that does not clean well or has deep scratches.

Removal

WARNING: Handle all disks with nylon gloves to prevent fingerprints on the disks.

1. Obtain disk replacement kit (P/N 2108433) and clock writer (B/M 2108620) from Emergency Parts Center (E.P.C.).
2. Read data from all disks if possible. Store this data so it can be rewritten after the disks are replaced.
3. Remove AC and DC file power.
4. Remove glass doors from both sides of the machine.
5. Swing out receiver and remove drawers, place in plastic bags in which they were received, and place in slots in shipping cartons.
6. Remove canopy grill and disk array filter. (See 3.1.1).
7. Remove the two rearmost screws from the top and bottom of the front support casting and rotate casting 90° clockwise, away from the disk array (Figure 3-6). DO not bend, or tear strut alignment shims.
8. Remove all shields that house the disk array. (See 3.1.2).

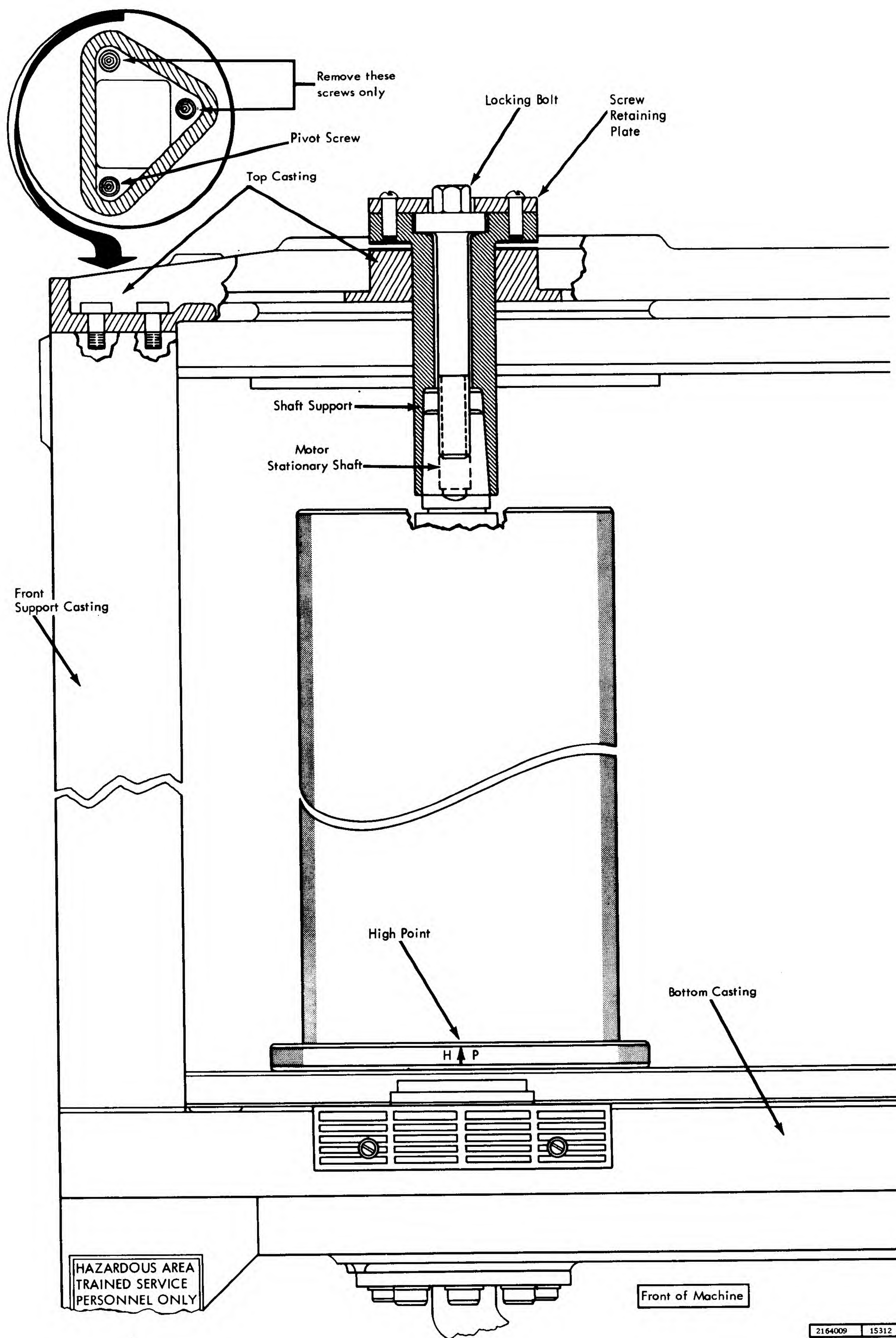


Figure 3-6 Shaft Motor

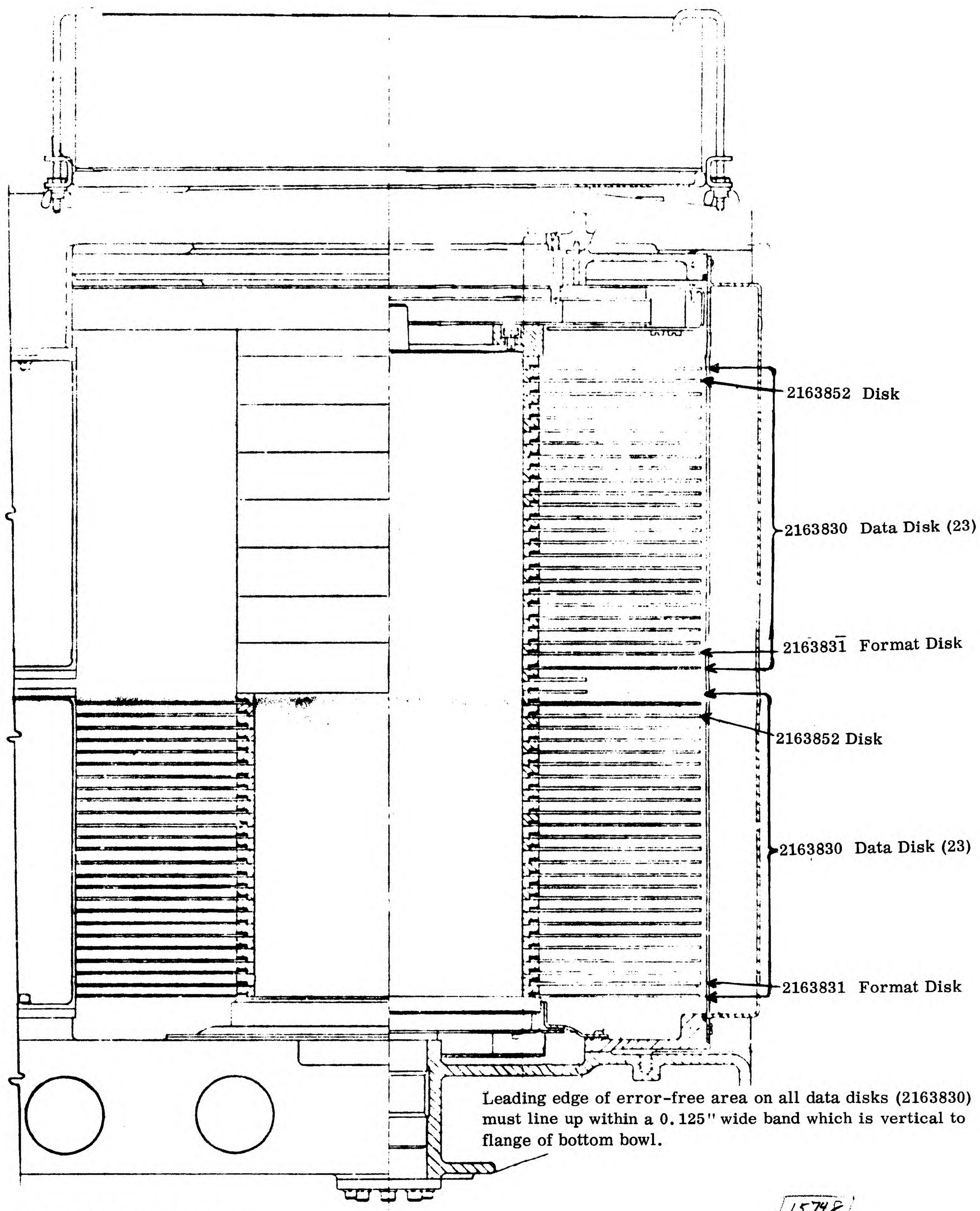


Figure 3-6a Disk Stacking

9. Mount the disk scribing and aligning fixture assembly (Figure 3-7) to rear support casting and tighten the two screws ± 10 in. lb torque.

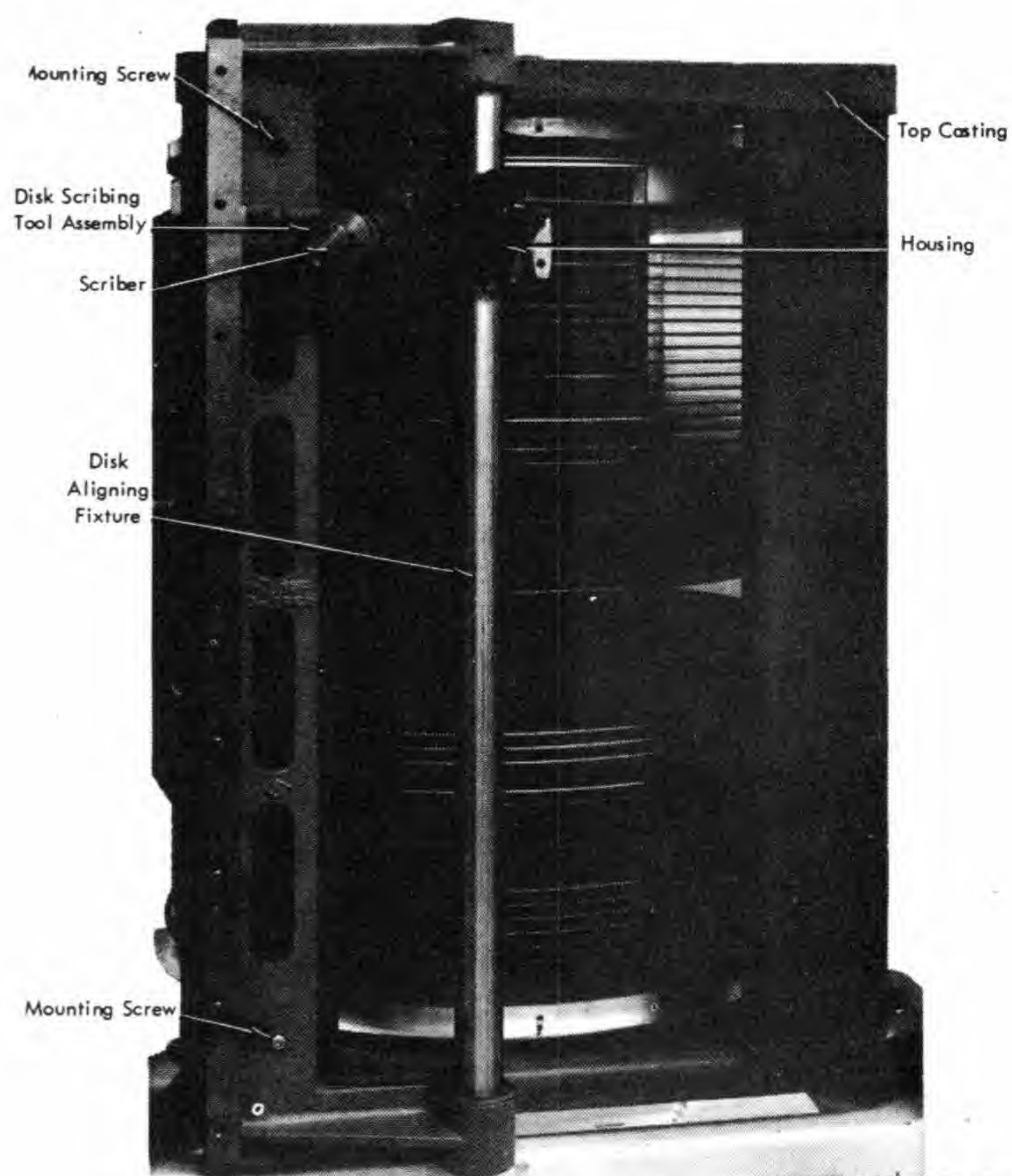
WARNING: Do not loosen these screws until disks have been installed and realigned.

10. Remove locking bolt (Figure 3-6). During this removal process, the locking bolt will exert a lifting force on the bottom of the screw retaining plate. This lifting force will raise the screw retaining plate and the shaft support stationary shaft. Do not remove locking bolt or shaft support from top casting. If just restacking disk, raise it so that its underside is flush with bottom of top casting. Use aluminum spacer block from disk alignment kit to prevent its falling and damaging disk surface. If replacing shaftmotor, remove entirely.
11. Lock shaftmotor with shaftmotor clamp to keep disks from rotating during disk scribing operation (Figure 3-8).

NOTE: If the disks have been previously scribed, these scribe marks may be used for realignment, and rescribing is unnecessary; however, verify that all disks are scribed and properly aligned before using any previous marks.

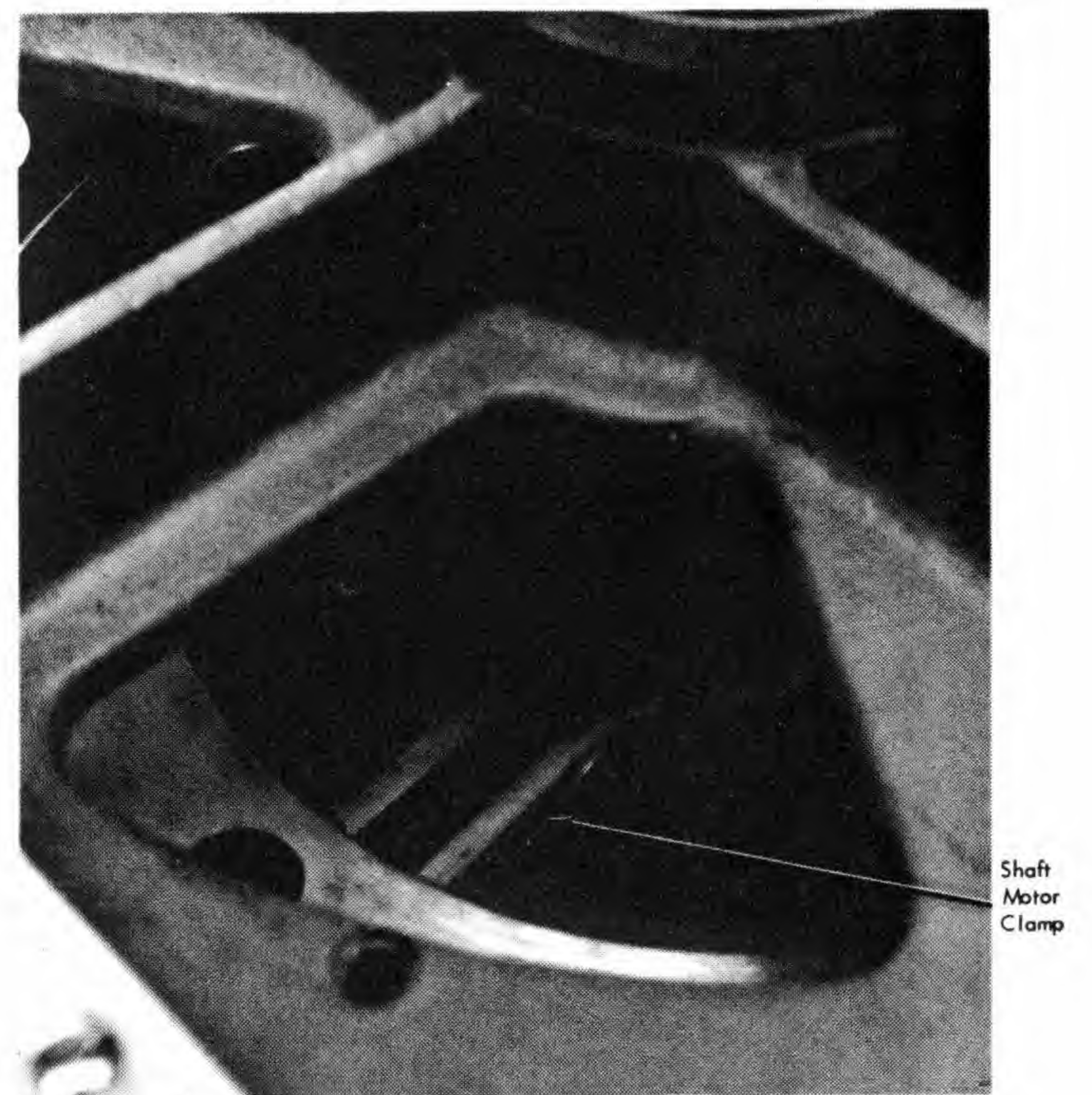
If the previously scribed marks are not to be used, mark them out with a narrow (1/8" to 1/4") ink strip. (A wider strip could be confused with the error free area.)

12. Insert the disk scribing tool assembly into housing (Figure 3-7). Rotate scriber until point is just short of making contact with edge of disk (Figure 3-9). Move scribing tool up and down over the full length of the disk edge, while slowly rotating scriber, until disk is scribed. Back out scriber while moving from one disk to another. Remove scriber.
13. Remove the six screws (Item A, Figure 3-10) which fasten the impeller housing assembly to the top casting.
14. Remove four screws (Item B, Figure 3-10) which fasten top bowl assembly to top casting. Remove top bowl through front of the machine (Figure 3-11).
15. Remove four screws (Item C, Figure 3-10) which fasten impeller to top clamping ring. The impeller housing cover, impeller housing, and impeller can be removed through the front of the machine as an assembly (Figure 3-11).
16. Remove the six disk clamping ring screws (Item D, Figure 3-10) and the clamping ring.
17. Separate each spacer ring from each disk before taking them off the shaft motor, if, they are taken off together the ring blocks and spring will tend to scratch the shaft motor. As the spacer and disks are removed from the shaftmotor, they should be stacked on a firm table or bench, one on top of the other in a reverse stack. Mark disks in the uncoated area where the disk part number (P/U) is stamped. Start numbering spacers and disks with #1. Lint-free tissues should be placed on top of the table before stacking.



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Figure 3-7 Disk Scribing and Aligning Fixture



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Figure 3-8 Shaft Motor Clamp

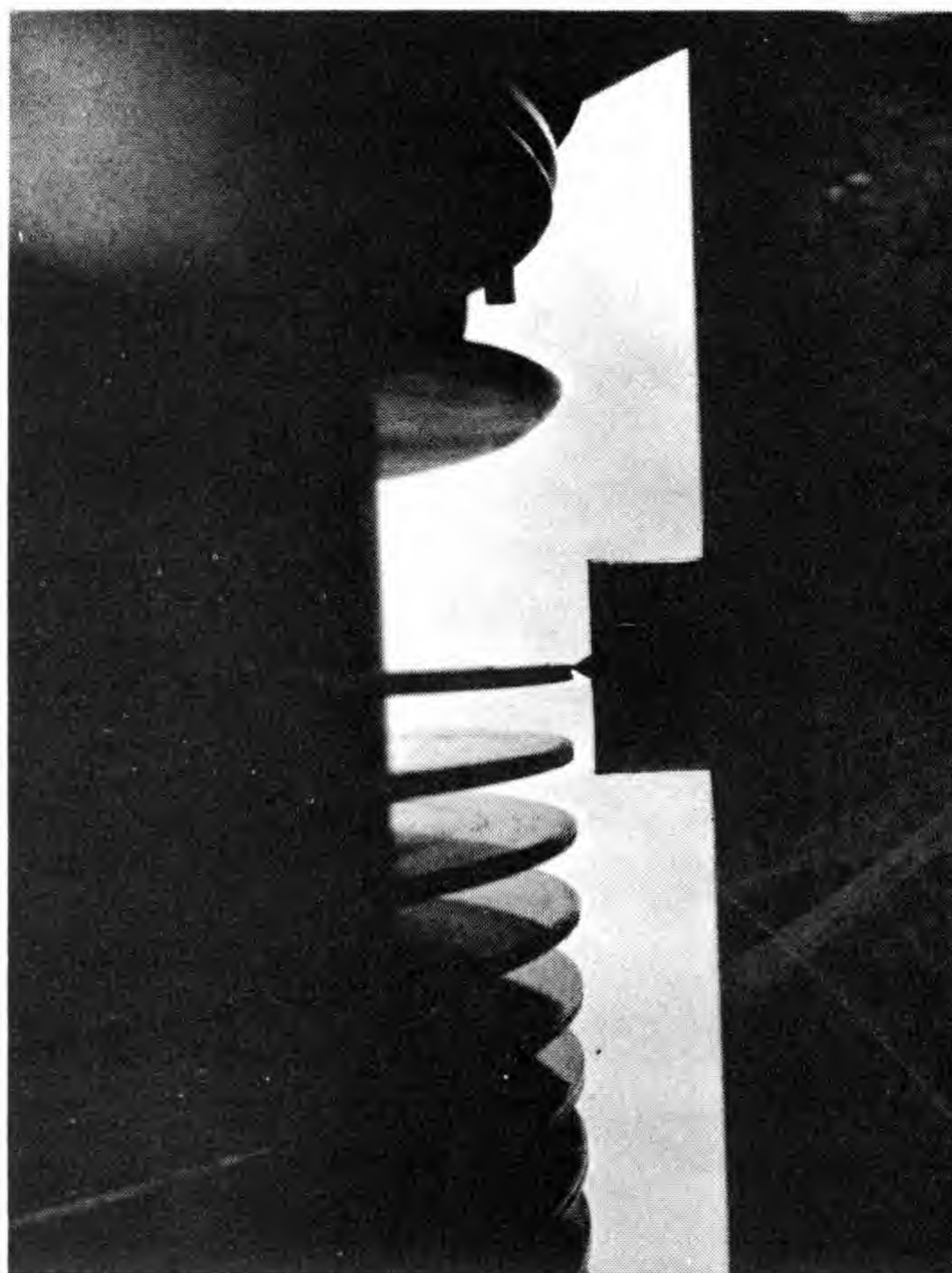


Figure 3-9 Disk Scribing

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Replacement

NOTE: Use a vacuum cleaner (approved IBM style) during disassembly and reassembly to remove chips and dirt generated by removal and replacement of screws. Before restacking disks, vacuum disk-array chamber thoroughly and search out all corners and crevices to remove any accumulated dust, dirt, and chips.

WARNING: Precautions should be taken to prevent dropping any metal chips or dirt into the top of the shaftmotor or disk array during assembly.

1. If the spacer below the clock disk was removed, install it with its scribed mark aligned within 0.5" of the shaftmotor high point (H/P). All other spacers are self-aligning and must be installed highest-numbered spacer first. Check each spacer spring for damage and replace if necessary.
2. Install first disk (highest-numbered) with P/N facing upward. The leading edge of the error free sector (dimple on edge of disk) must be aligned within 0.5" of the shaft-motor high point (H/P).

WARNING: When stacking disks, try to align the scribe before settling the disk on the spacer ring. If the disks are rotated after they are put on the ring, there is a possibility that the aligning blocks can shave the inner disk edge.

3. Install microscope into disk aligning fixture in scriber mounting. Align the scribe mark with the center of the cross-hair by positioning the disk. Then the microscope should be rotated to appear as shown in Figure 3-12.
4. Install balance of disks and spacers in numerical sequence. Wipe each disk with isopropyl alcohol and lint-free tissue. Replace any scratched disks. Align each disk as it is installed. If replacement disks are required, line up leading edge (in direction of disk rotation) of error free sector (black stripe on edge of disk) with error free sector of existing disks. The leading edges should line up vertically within .125 inch wide band. See Figure XX for disk locations, data, format, etc.

NOTE: Due to the thickness of the rubber gasket on the spacer assembly on the two module file, it is possible that only 49 disks can be installed the first time. It is necessary to install the top spacer assembly and the top clamping ring to compress the array. When locating the mounting holes of the ring to the shaftmotor, try not to rotate it, for it will tend to move the top spacers and disks also. Use the three long clamping ring screws to secure the disk clamping ring to the shaftmotor. Two men should tighten down opposite each other, turning the same amount of turns. Then check the final set of the torque on the clamping ring screws for 230" + - 10" lb.

5. Remove screws, clamping ring, and top spacer and install last disk and reclamp to 230" \pm 10" torque. Recheck two or three

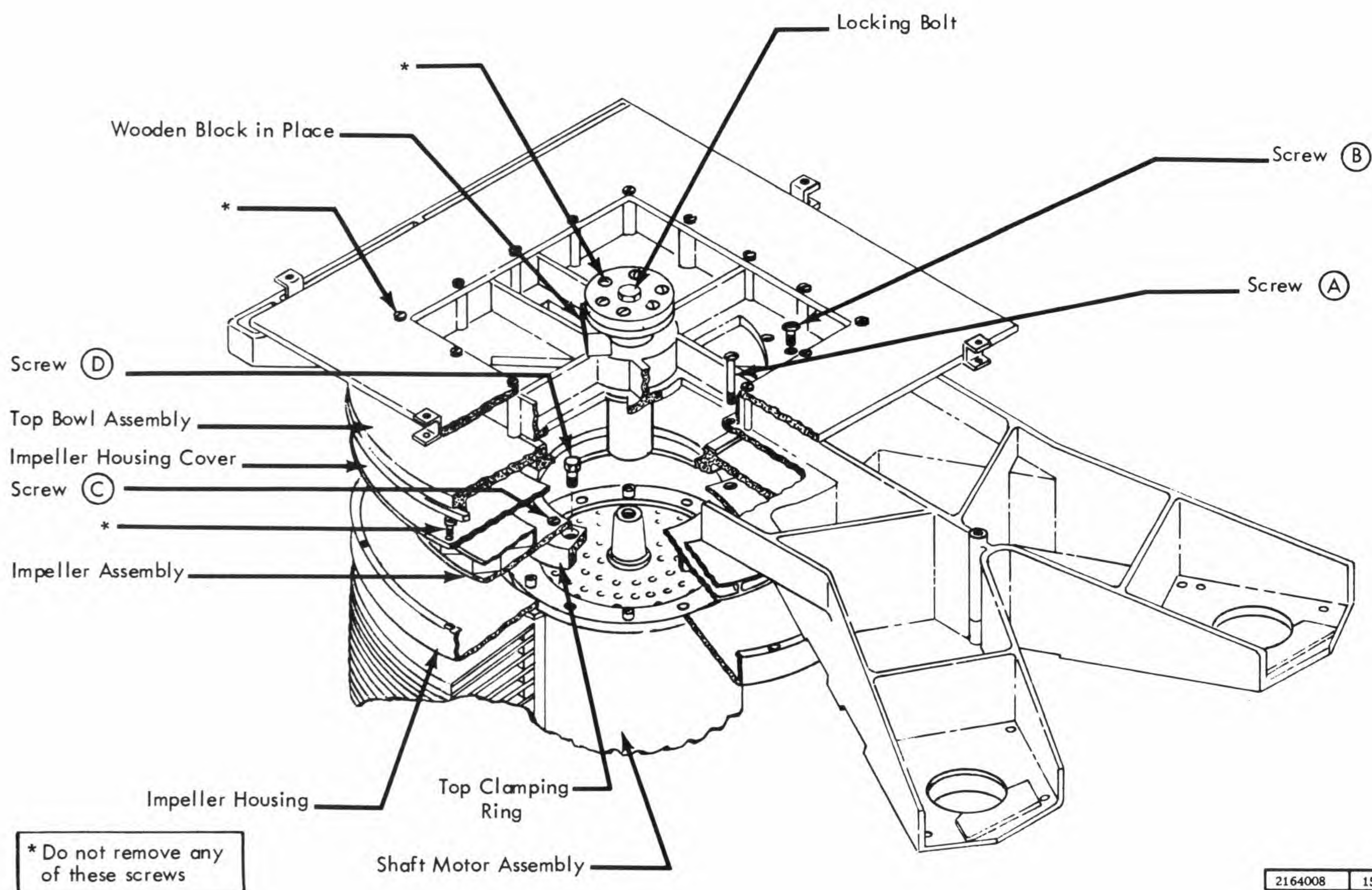


Figure 3-10 Disk Array Disassembly

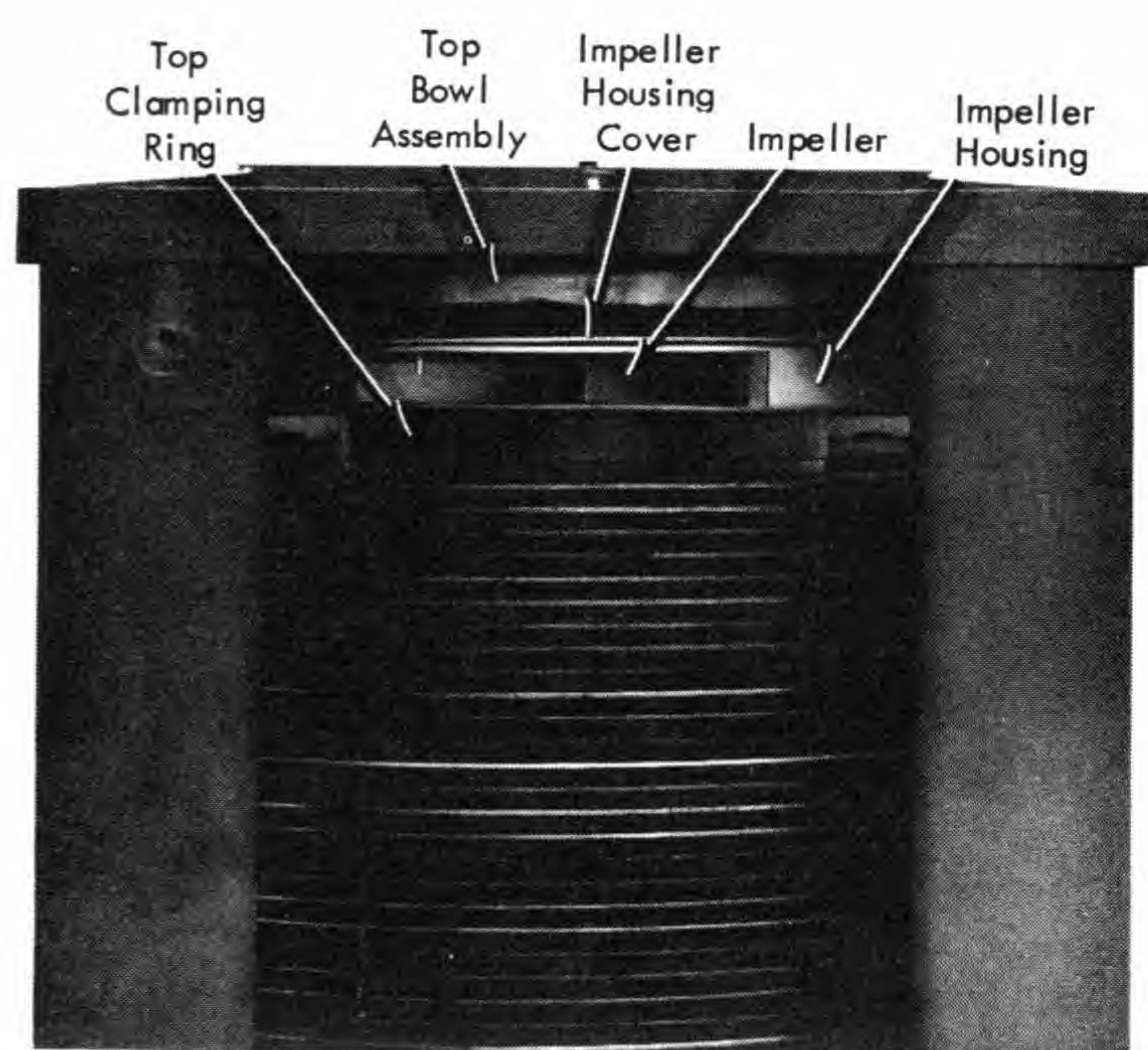
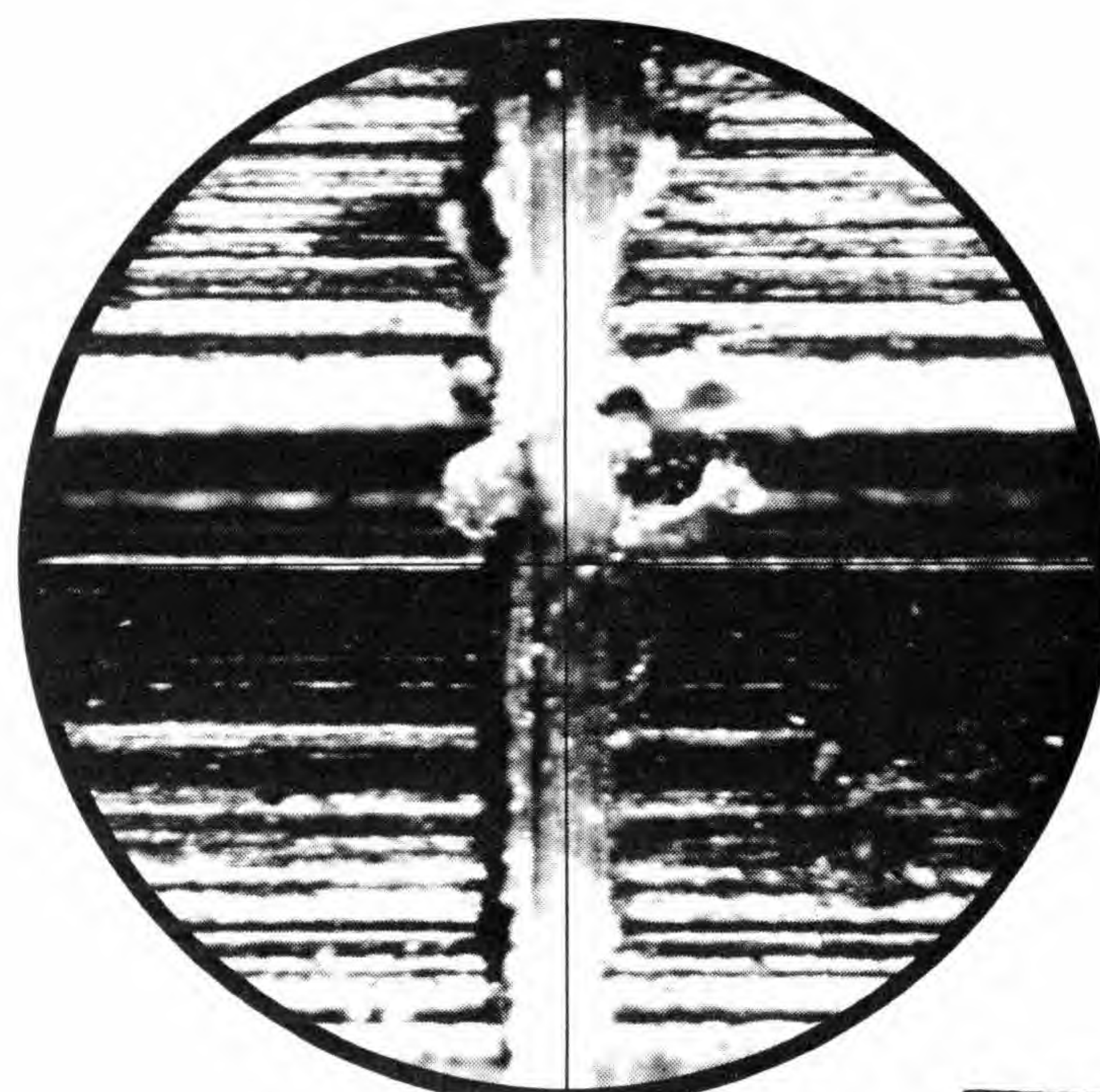


Figure 3-11 Disk Array Assembled

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Figure 3-12 Magnified Scribed Line on Disk

disks to verify that the scribe marks have not moved during the clamping operation.

6. Check disk runout of every fifth disk with dial indicator from disk-aligning kit. Measure runout at $3/16"$ + $1/16"$ from the edge of disk while turning the array manually through a full revolution. Measure runout from the bottom surface of the disk (Figure 3-13). Runout should not exceed $0.020"$. If a disk is found that exceeds a total indicator reading of $0.020"$, it may be an indication that one of the lower disks or spacers does not lay flat, possibly due to a chip between the surfaces. If such a disk is found, disks beneath it should be checked to determine the disk at which runout becomes excessive. The disks must then be unstacked to locate the problem. If only one disk has excessive runout, then the disk runout log should be checked to verify if the disk initially had much runout. If it did not, then the disks must be unstacked to locate the problem.
7. Remove the disk aligning tool from the rear support casting, place in shipping crate, and return to E.P.C. (Emergency Parts Center). Replace support casting, shims, and screws.
8. After installing disk array shields, slowly rotate the disks array by hand to ensure that the index slugs do not contact the index transducer pole tips. If there is contact, back off the transducer.
9. Clean the disks (refer to Disk Cleaning). Mount the drawer assemblies to the receiver (refer to Drawer Installation.) Swing in the receiver (refer to Swing In Procedure) and mount the access cover. Installation.) Swing in the receiver (refer to Swing In Procedure) and mount the access cover.
10. Purge the file for at least 45 minutes before loading the heads on the disks under power.
11. Perform complete rewrite of all disks in the array.

3.1.5 DISK SHAFT MOTOR

Service Check

The start of a shaft motor failure may be indicated by:

1. Noisy bearings.
2. Timing problems in the machine.
3. Overloads do not stay closed.
4. Thermal switch opens on starting.
5. Rundown time less than 60 percent of that recorded on decal (P/e 2123138 on cover of power sequence gate).

Removal

Order the shaft motor by part number (see Parts Catalog). The shaft motor-and-hoist kit and the disk-aligning kit will be automatically sent with the motor. Instructions for removing and replacing the shaft motor are included in the shaft motor-and-hoist kit.

Rewrite all disks in the array after shaft motor replacement.

3.1.5.1 Disk Drive Thermal Overload Switches

Service Hint

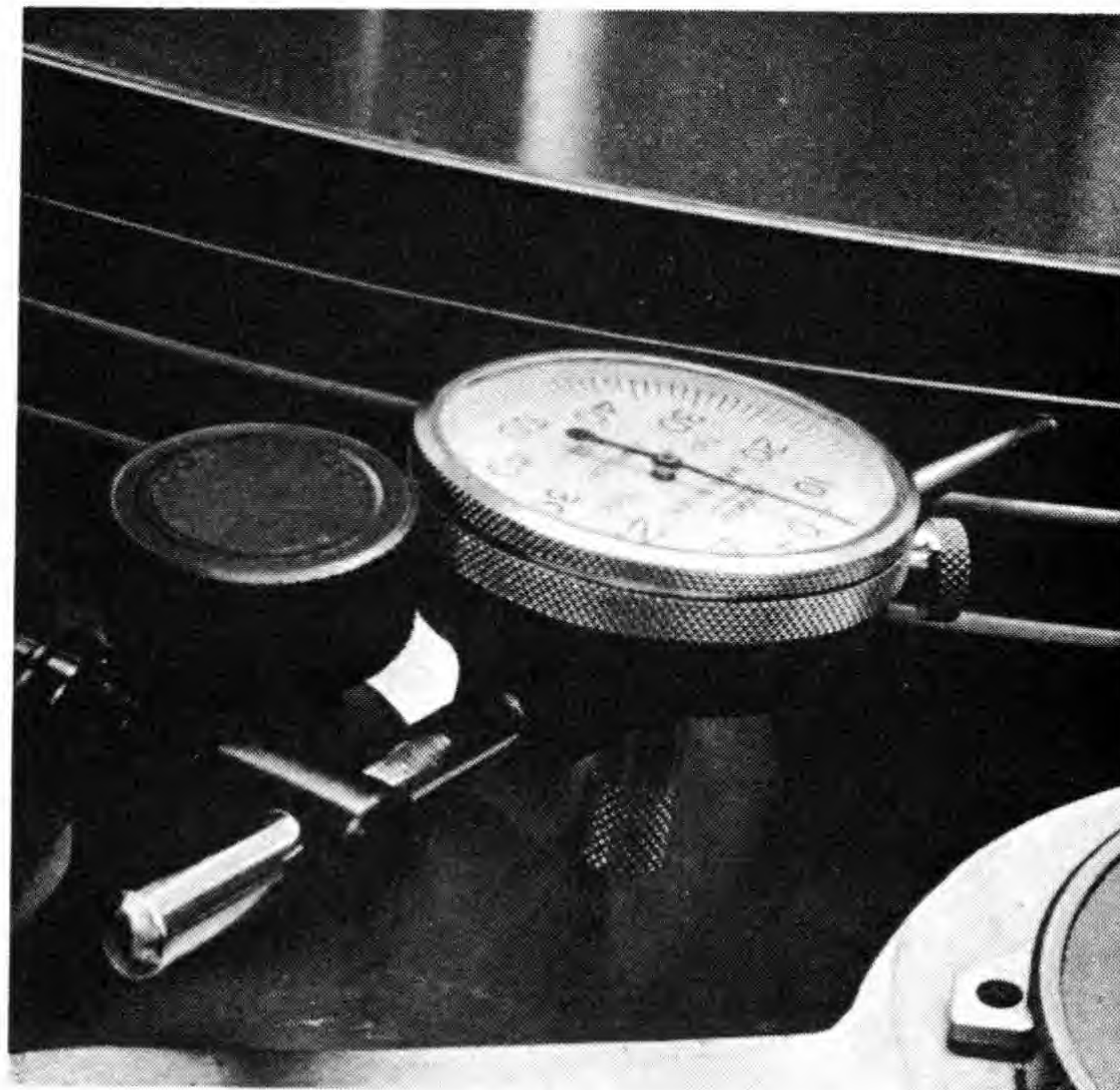
A "spare" Thermal Overload switch is installed on the disk drive motor. Should the switch become defective, the spare switch can be installed by interchanging the leads X2 and X1 located in the contactor cabinet (Figure 3-14). The switch appears on page 01.50.12.0 of the 1302 system diagrams.

If both switches are defective, disconnect and tie back leads from both switches and jumper across the terminals where X3 and X1 or X2 was attached. Adequate protection is still provided in the power sequence gate.

3.2 RECEIVER ASSEMBLY

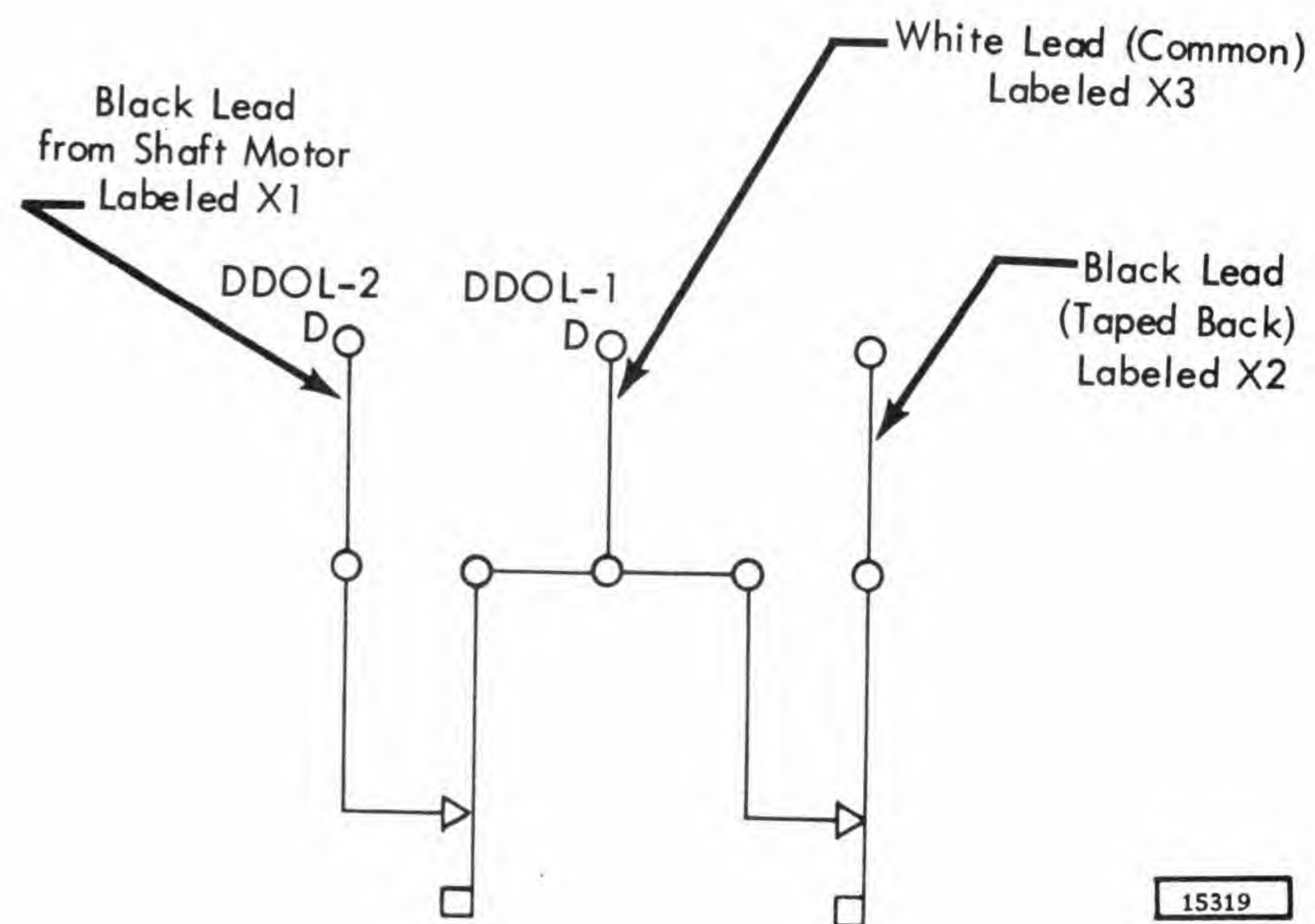
Swing-Out Procedure -- Disk Array Stopped (Figures 3-15 and 3-16)

1. Remove power to machine.
2. Remove glass doors.
3. Remove access cover and sliding door.
4. Move carriage to outer limit stop. For the rear actuator, it will be necessary to remove the dummy rear crash stop.
5. Loosen the two set screws at the rear of the carriage swingout shaft housing. Loosen the outer most screw on the swingout shaft cap. Disconnect receiver cable from end of bridge assembly.
6. Depress carriage locking levers. Apply a slight inboard pressure on the receiver to aid in unlocking. Do not press on arms or stiffeners.
7. Swing receiver out carefully. Make sure flex rings clear the disk array shields.



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Figure 3-13 Dial Indicator Mounting



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Figure 3-14 Additional Disk-Drive-Motor Thermal

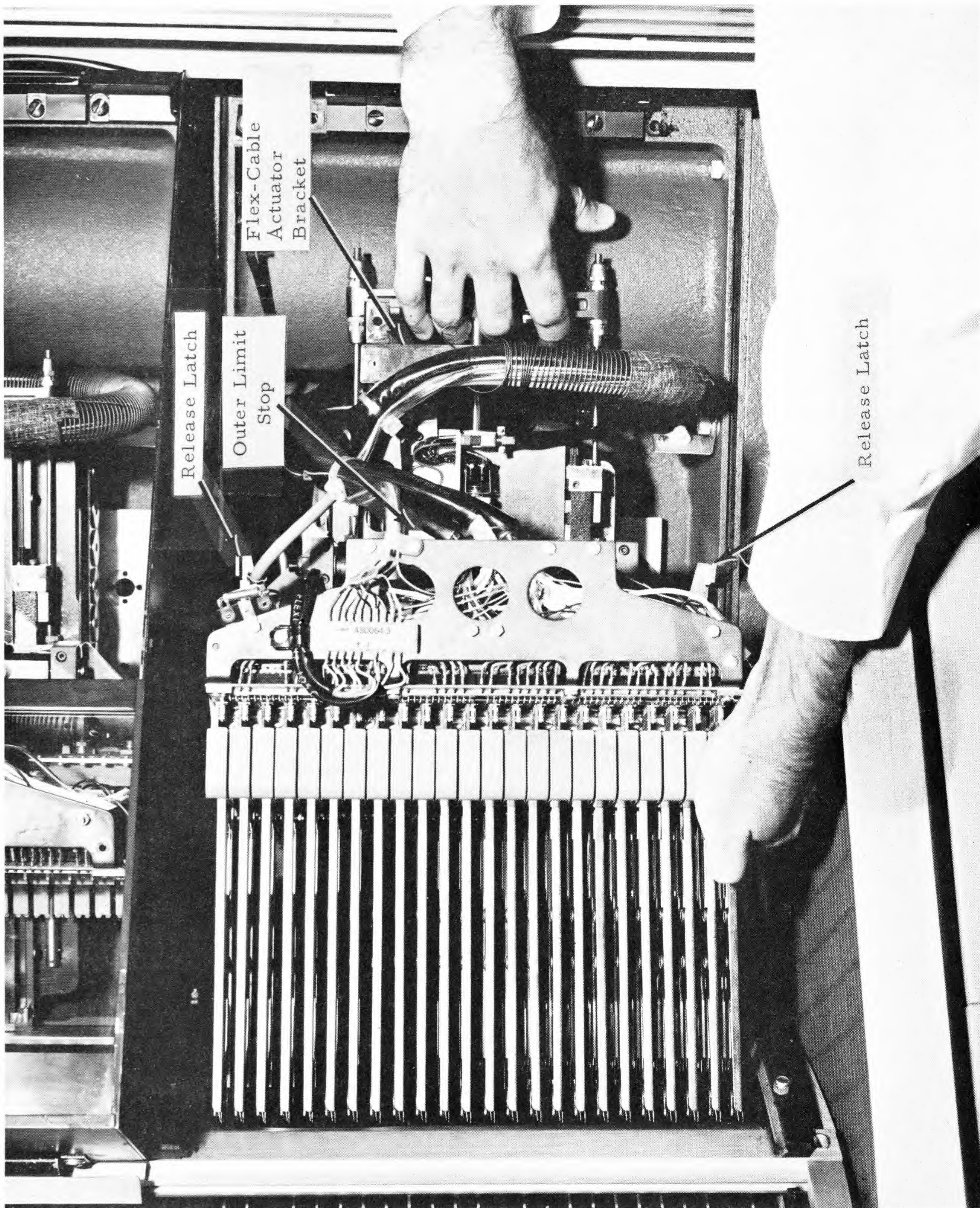


Figure 3-15 Receiver Swing-out Procedure

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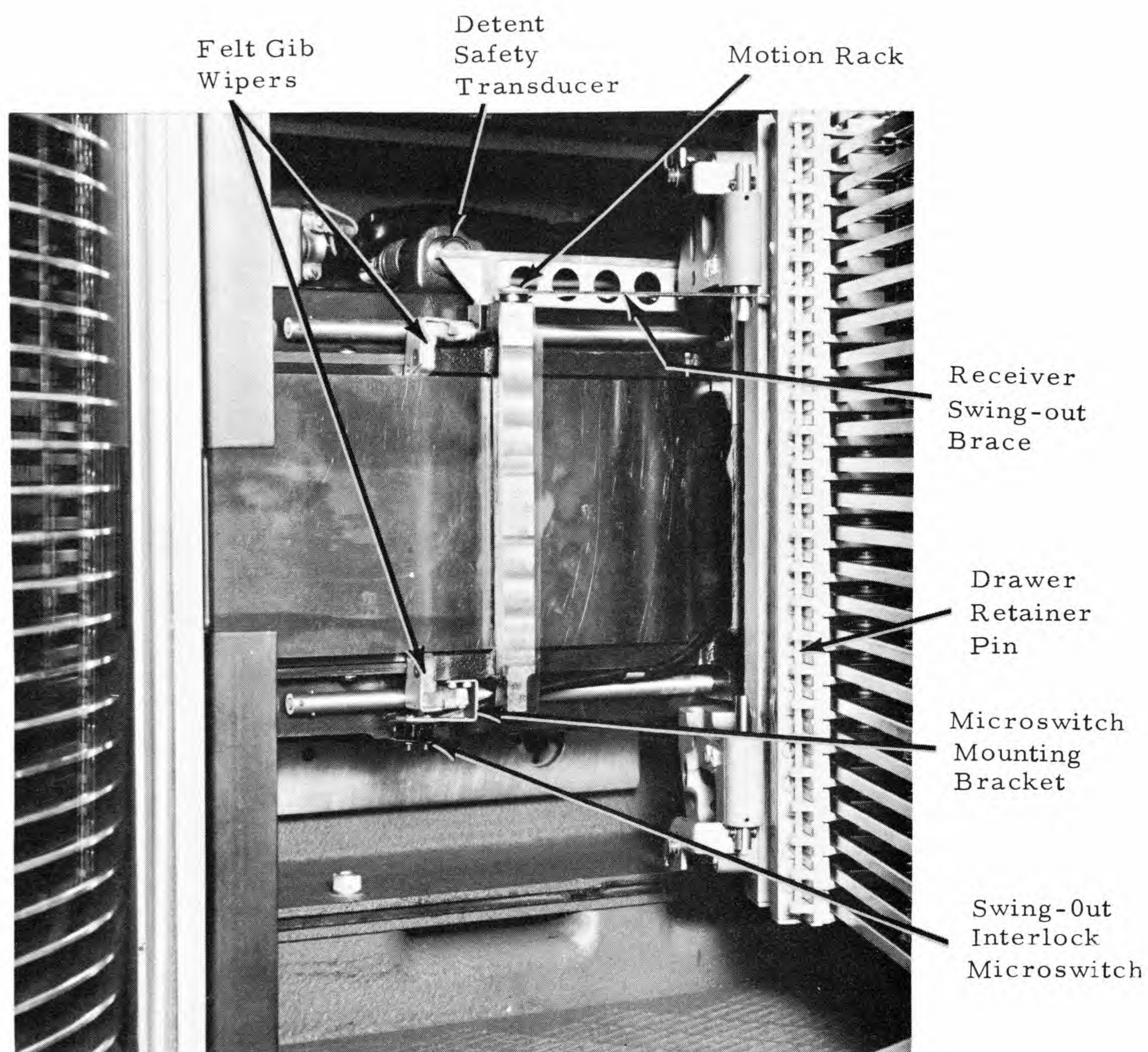


Figure 3-16 Receiver in Servicing Position

8. To retain the receiver at a fixed location, attach swing out brace (P/N 2192836).

WARNING: ANY time the receiver is swung out, drawers and heads are in an extremely vulnerable position. Do not leave the receiver unattended while in this position.

9. Cover access-entry port with long door.

Swing-in Procedure -- Disk Array Stopped

1. Swing receiver in far enough to allow installation of actuator shield. Install shield.
2. Remove long door.
3. With carriage against outer stop, swing receiver in carefully.
4. Press on receiver to lock wedges. Do not put any pressure on drawer stiffeners. Apply slight pressure on levers in direction of spring force. Observe profile of drawers between disks. All drawers must be equally spaced between disks. If any drawer appears to be badly misaligned - replace drawer.
5. Tighten the outer screw on the swingout shaft cap.
6. Tighten the two carriage swingout shaft set screws. Connect receiver cable to bridge assembly.
7. If rear actuator, install dummy outer limit stop.
8. Install actuator shield door and sliding door. Inspect clearance between sliding door and drawer assemblies. This should be 1/8" minimum to 3/16" maximum. Bend stop on access shield if required.
9. Turn on File DC and hydraulic power supply.
10. After 30 minutes, of purging and warm up, the file can be brought on line.

Swingout Procedure -- Disk Array Coasting Down

1. Remove power to machine.
2. Remove glass doors.
3. Remove the short door on the actuator shield next to the disk array port.
4. Remove the actuator shield door.
5. Move the carriage to the outer limit stop. For the rear actuator, it will be necessary to remove the dummy rear crash stop.

6. LOosen the two set screws at the rear of the carriage swingout shaft housing. Loosen the outermost screw on the swingout shaft cap. Disconnect receiver cable from end of bridge assembly.
7. Depress carriage locking levers. Apply a slight inboard pressure on the receiver to aid in unlocking. Do not press on drawer stiffeners.
8. Swing receiver out carefully. Make sure flex rings clear the disk array shield.
9. Cover the access entry port with long door.
10. Remove the actuator shield. Retain the receiver in place using the swingout brace (P/N 2164240).

WARNING: Anytime that the receiver is swung out, the drawers and heads are in an extremely vulnerable position. Do not leave the receiver unattended while in this position.

3.2.1 RECEIVER AS AN ASSEMBLY

When a receiver is removed and reinstalled or a new receiver substituted, it is necessary to read out the data and rewrite with the new assembly. If possible, the reading out of all the data serviced by that access should be done prior to disassembly in order to eliminate the necessity of readjusting the yoke and/or using the tool drawers.

Removal (Figures 3-15, 3-16, 3-18, and 3-19)

1. Read data from all the disks serviced by this receiver. Store this data so it can be rewritten after the receiver is replaced.
2. Swing out Receiver (see Receiver Swing out Procedure Section 3.2).
3. REMove the drawer retaining pin and the drawer assemblies.
4. Tighten the swingout shaft cap screws and the two set screws on the carriage.
5. LOosen the hinge shaft nut a few turns.
6. REMove the air hose from the head load air cylinder.
7. Disconnect the connector from the swing-out interlock microswitch, head load switch, and head unload switch.
8. Remove the head load and unload microswitch assembly.
9. Remove the receiver printed circuit board assembly by removing the mounting screws.

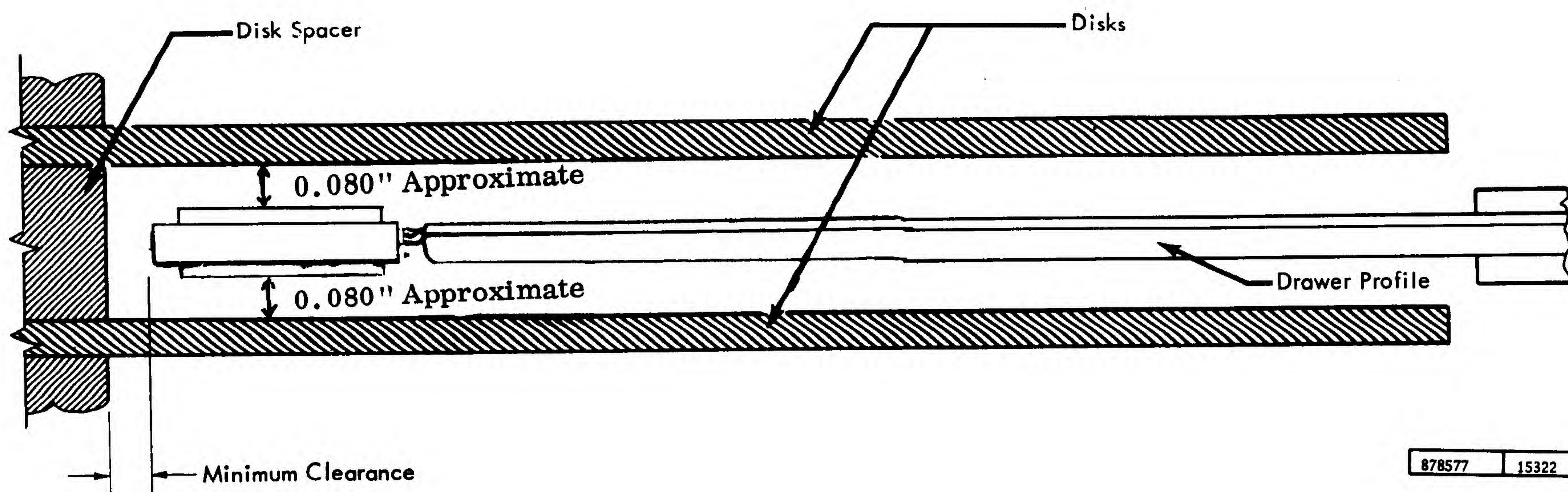


Figure 3-17 Drawer Assembly Profile

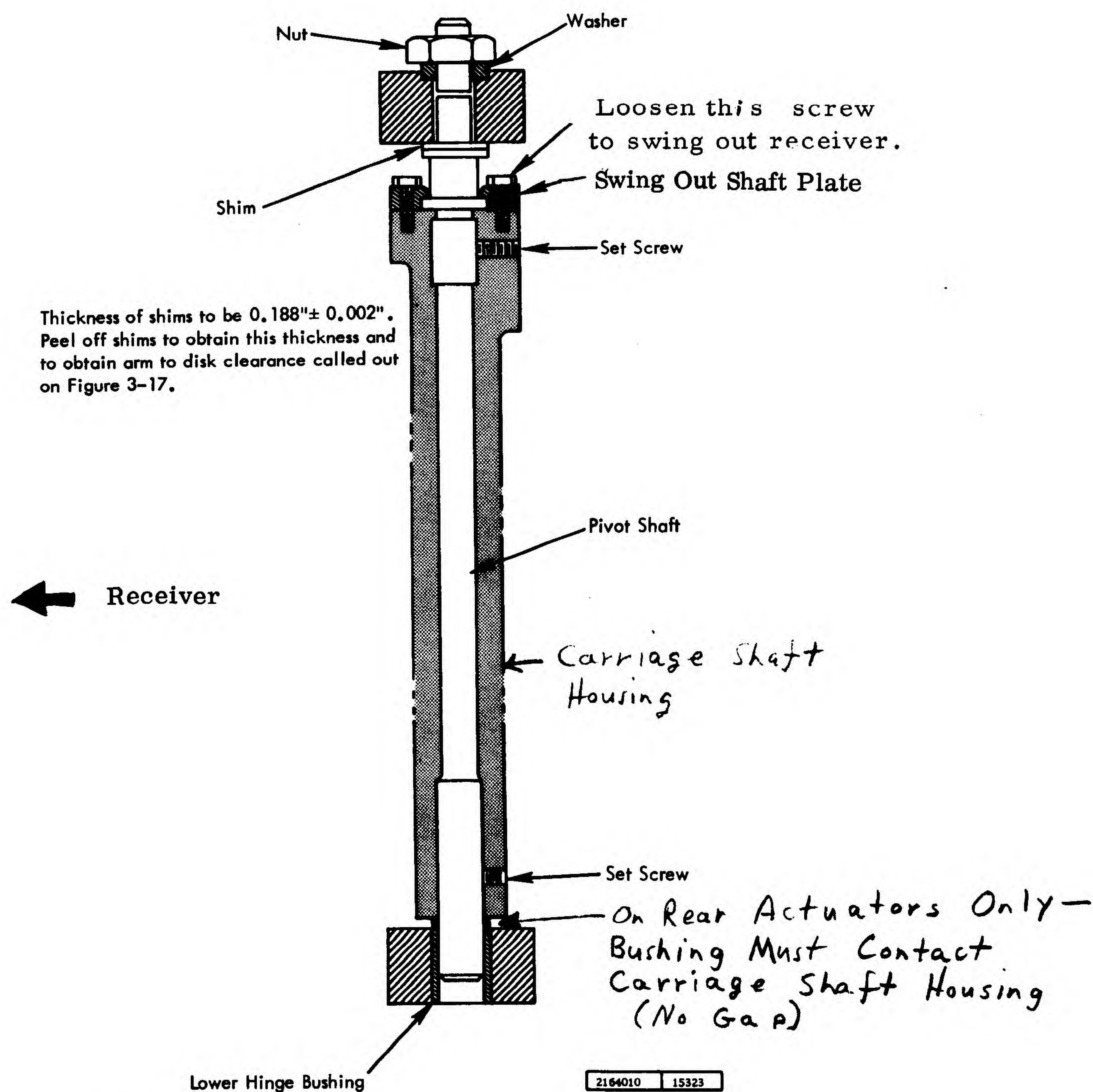


Figure 3-18 Pivot Shaft Assembly

Figure 3-19 (Deleted)

10. Remove both hinge caps and remove the receiver. This step requires two people.

Replacement

1. Move the carriage to outer limit stop.
2. Check to verify that the swingout shaft cap screw and the two carriage set screws are tight.
3. Position receiver hinge arms on shaft assembly. Ensure correct position of shim spacer and split bushing during assembly. This step requires two people.
4. ASsemble hinge caps to arms and tighten as follows:
 - a. Tighten hinge cap screws while maintaining an even gap on each side of the cap.
 - b. Loosen each cap screw by turning approximately 30°. This allows shaft to move with caps during following step.
 - c. Torque nut to 30 ± 5 in lb.
 - d. Tighten cap screws.
5. Loosen the swingout shaft cap screw and the two carriage set screws.
6. Assemble the receiver printed circuit board assembly.
7. Assemble head load and unload microswitch and plug connector.
8. Connect air hose to the head load assembly.
9. Swing out receiver and engage swingout brace.
10. Install drawer assemblies and drawer retaining pin.
11. Check receiver and drawers for proper position and straightness.
12. Swing in receiver (see Receiver swing-in procedure Section 3.2).
13. Perform a complete rewrite of all disks serviced by this receiver.

Adjustment

Head Load.

Heads Unloaded Switch. With assembly in the heads unloaded condition the heads unloaded switch should be adjusted to just make with a 0.001" shim between the air-cylinder piston and the main-link roller

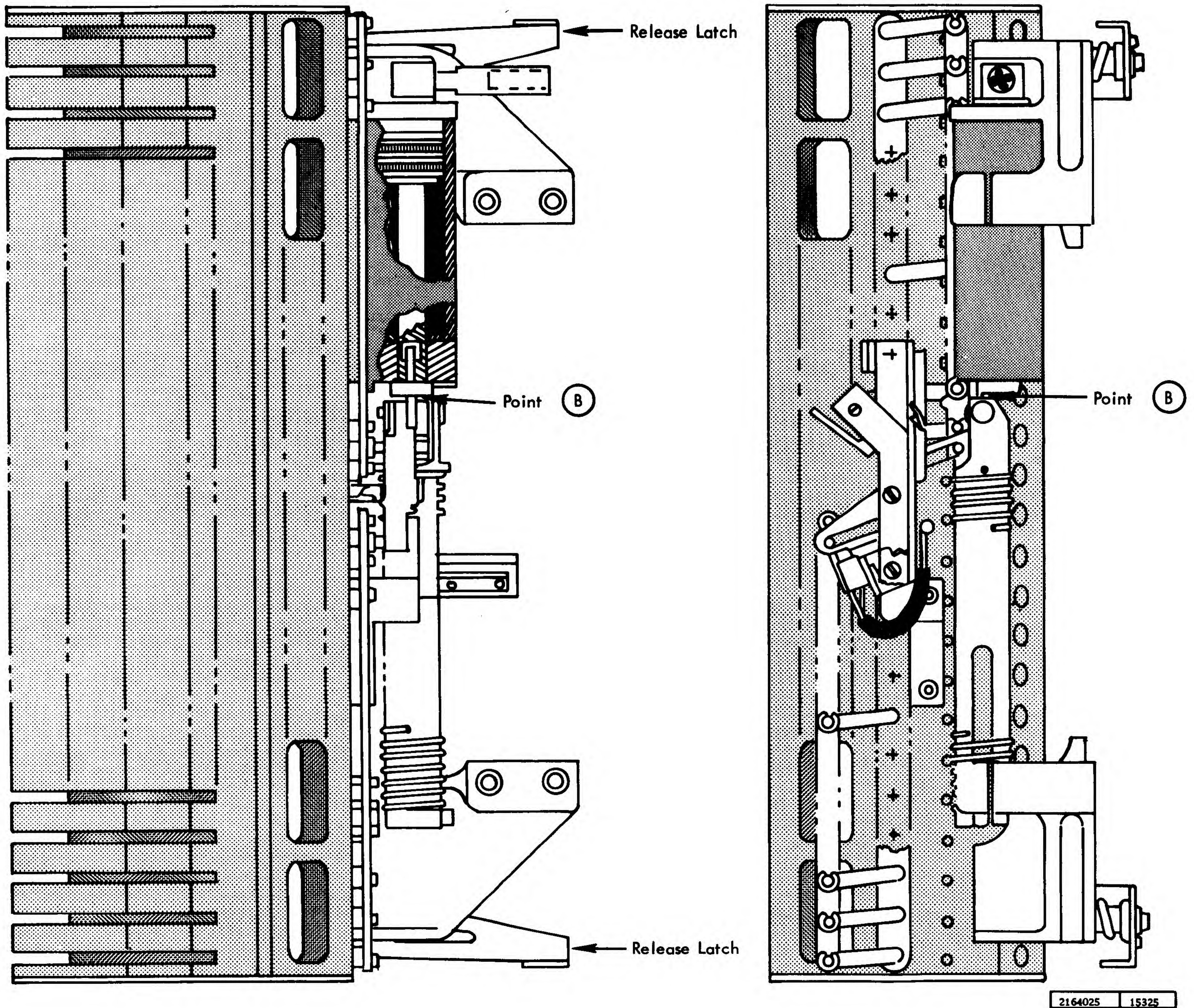


Figure 3-20 Head Load - Head Unload Adjustments

Figures 3-21, 3-22, 3-23, (Deleted)

(Point "B") and not made with a 0.005" shim at Point "B". (Figure 3-20)

Heads Loaded Switch. With 65 p.s.i. applied to air cylinder, adjust head load switch so that it is just made.

3.2.2 DRAWER ASSEMBLY

3.2.2.1 Drawer as an ASsembly

NOTE: Format drawers are not interchangeable with data drawers. Drawers from the front accesses are not interchangeable with drawers from the rear accesses.

ADjustment

The magentic elements in the drawer assembly are precisely located during manufacturing, and adjustment is not necessary or possible on drawer assemblies.

Removal

1. Read data from both disks serviced by this drawer. Store this data so it can be rewritten after the drawer is replaced.
2. Swing out receiver (see Section 3.2).
3. Remove drawer retaining rod. (Figure 3-16)
4. LOosen drawer retaining screw in rear of receiver.
5. Remove drawer assembly by applying a clamping force with index fingers and pushing on adjacent drawers with thumbs (Figure 3-26). Drawer assembly must be handled with care. Never handle assembly by stiffeners or arms.

Replacement

1. Check drawer to see if it is for the correct side (front and rear).

2. Check for proper position of torsion rod (Figure 3-25).
3. Insert drawer (Figure 3-27).
4. Seat drawer firmly by tightening the retaining screw.
5. Insert retaining pin through holes in drawers until cotter pin rests against top drawer.
6. Swing-in receiver (see Receiver Swing-in Procedure Section 3.2).
7. Rewrite both disk surfaces serviced by replaced drawer. If the data was not read out before removal of the drawer (Step 1 of Removal procedure), attempt to recover the data with the new drawer or if necessary, use a tool drawer (P/N 2164250 or P/N 2164251). After recovering data however, it must always be rewritten with the new drawer.

The adjusting screw on the tool drawer moves both heads so it may be necessary to readjust the drawer for each disk surface. See Section on head signals for method of peaking on signal.

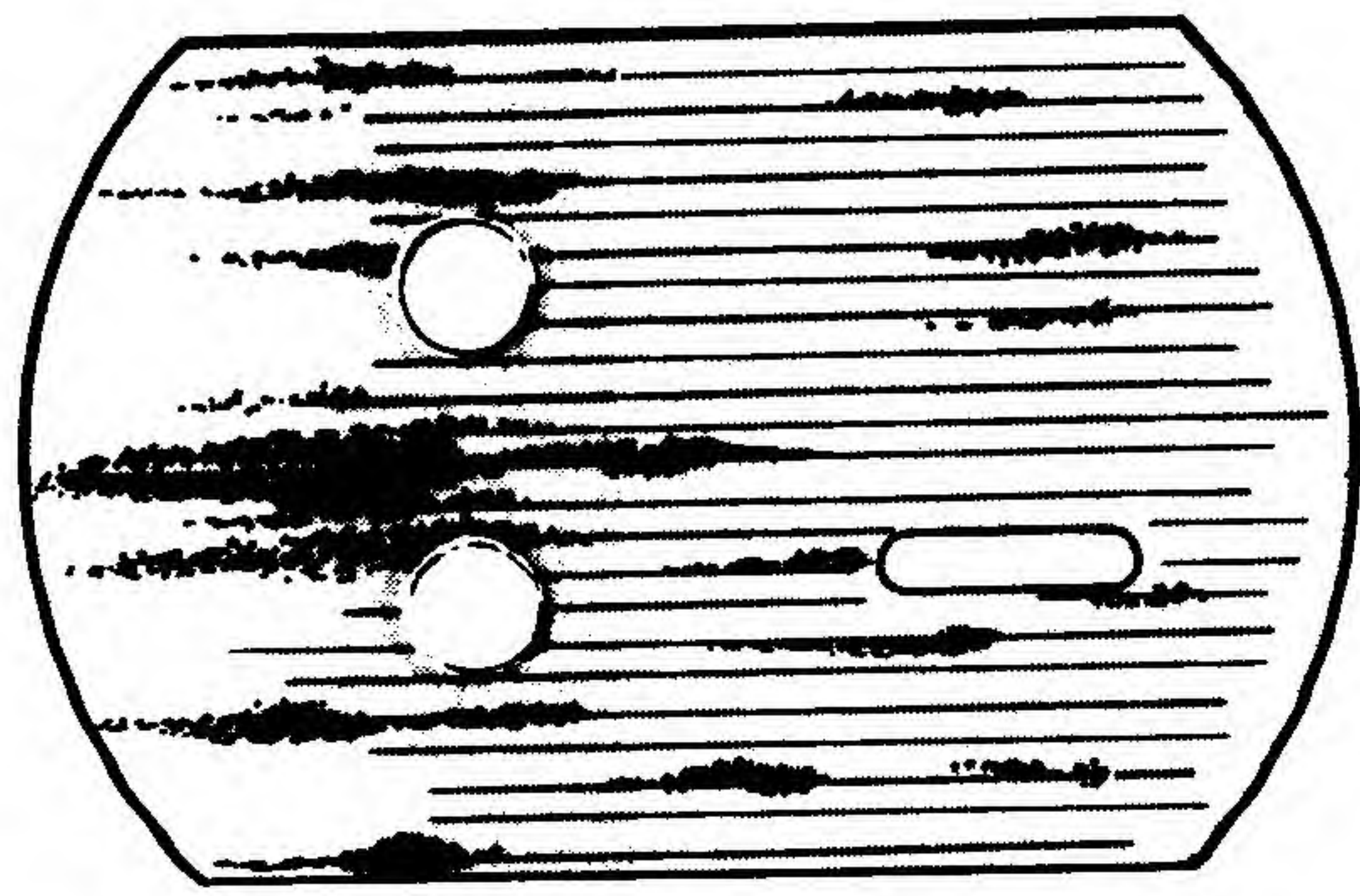
3.2.2.2 Head

WARNING: Electrical arcing between the head and disk can occur if a voltage of about 25 v is applied between the isolated receiver and frame ground.

This amount of voltage will cause damage under the following conditions:

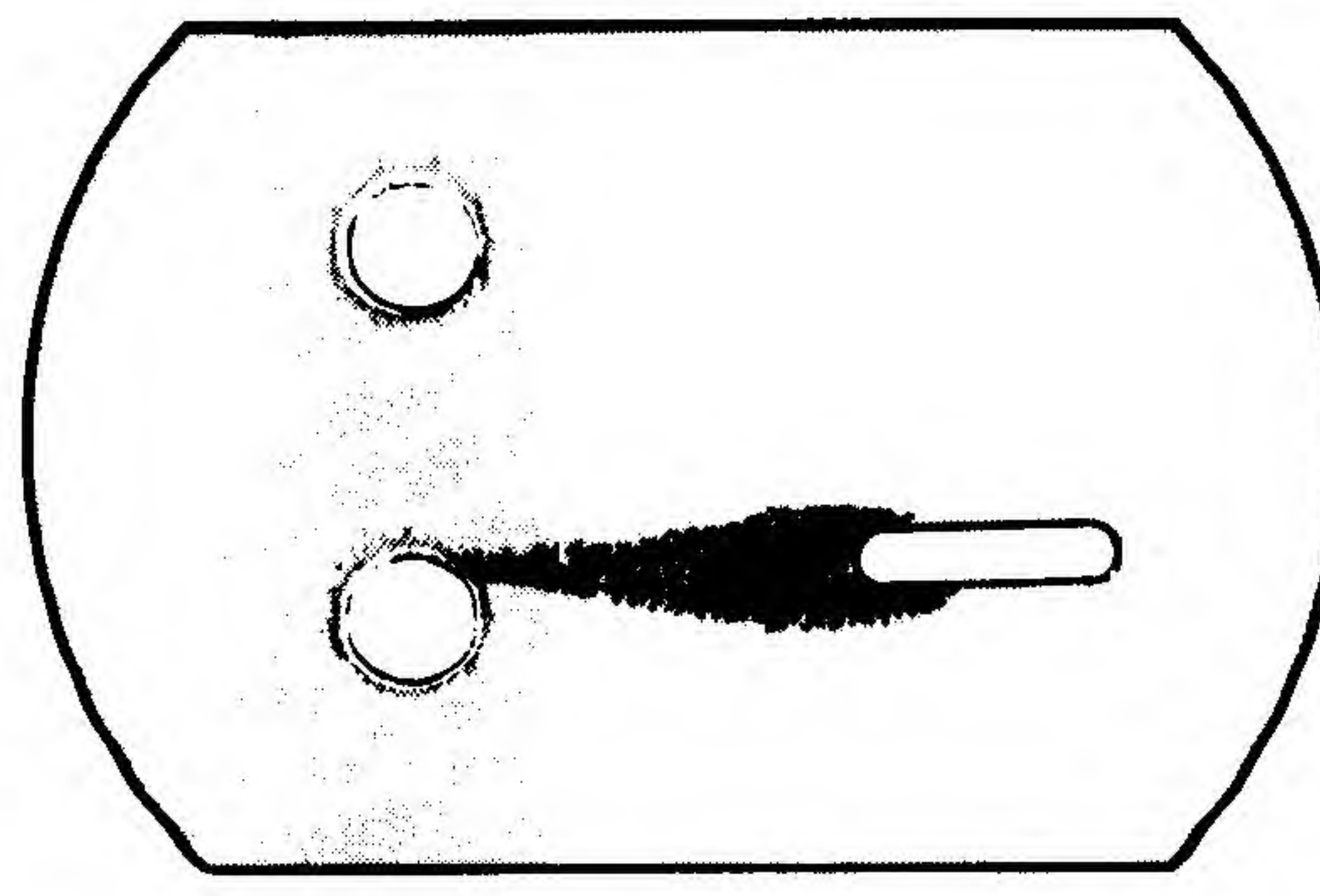
1. Assuming AC And DC Grounds are isolated, arcing may occur if a DC voltage is shorted to frame ground. The power supply fuse will not blow and damage may result if the head-disk spacing is less than normal for the voltages under 25 v and at normal spacing for higher voltages. It is very easy to short a DC voltage to frame ground during servicing, e.g., (a) a gate may be opened against a metal object such as a metal stool or an oscilloscope cart. The back panel wiring can then be shorted to frame. (b) Scope leads left dangling, etc., can also cause trouble.
2. If AC and DC Grounds are tied together at some point in the system, arching will not occur if a DC voltage is shorted to the receiver or to the frame. However, there exists the possibility of wiring errors or a loose or broken ground wire at the receiver, in which case a DC voltage on the receiver may cause damage. However, there exists the possibility of wiring errors or a loose or broken ground wire at the receiver, in which case a DC voltage on the receiver may cause damage.
3. 24v AC is present throughout the machine. A short between one side of the 24v line and DC ground would apply 24 volts directly across the receiver and the frame.

NOTE: Remove all drawer assemblies in the receiver if a megger is used to check isolation.



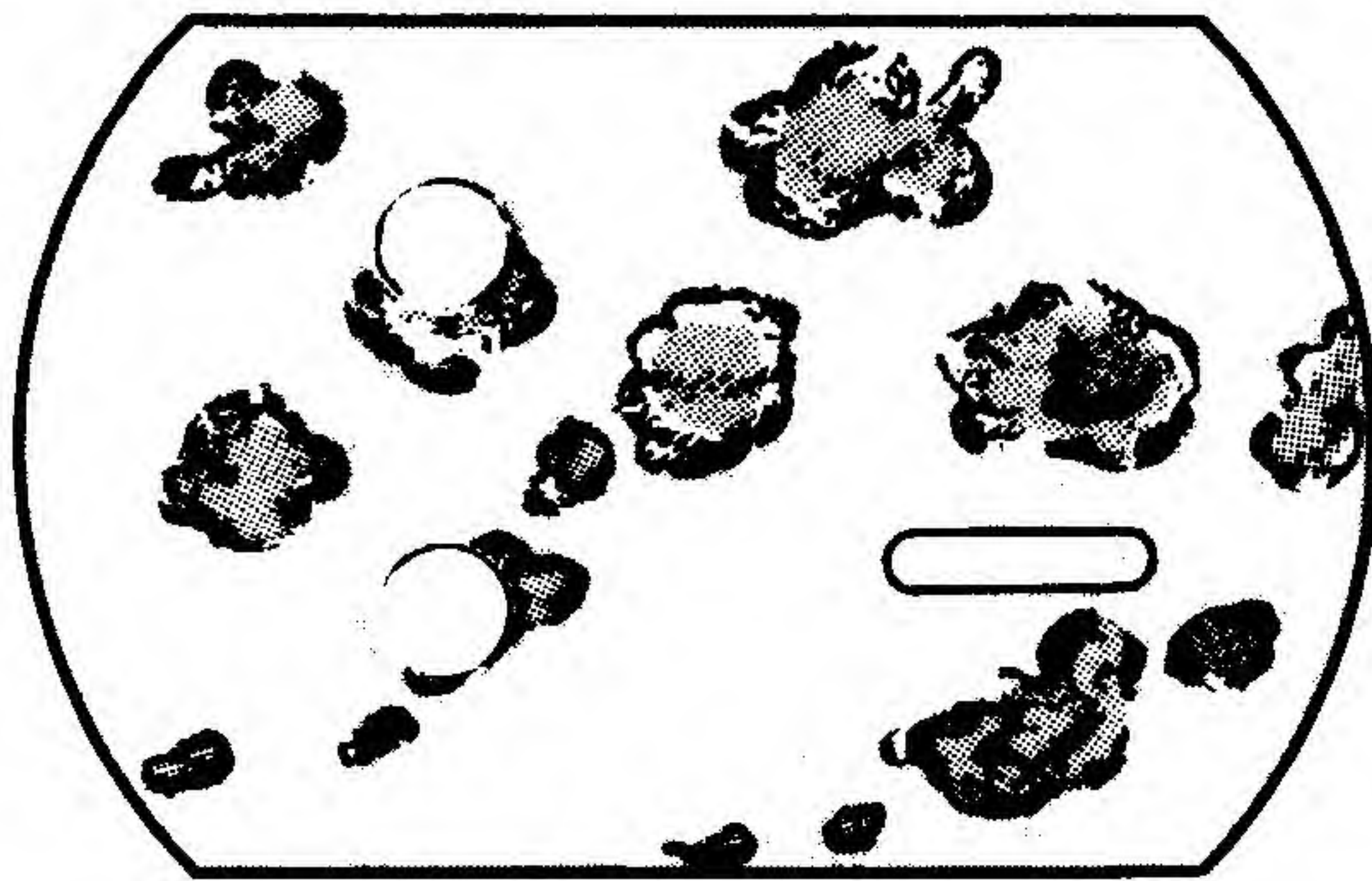
(A)

Scratches and Oxide Buildup Due to Scratches. Replace Drawer.



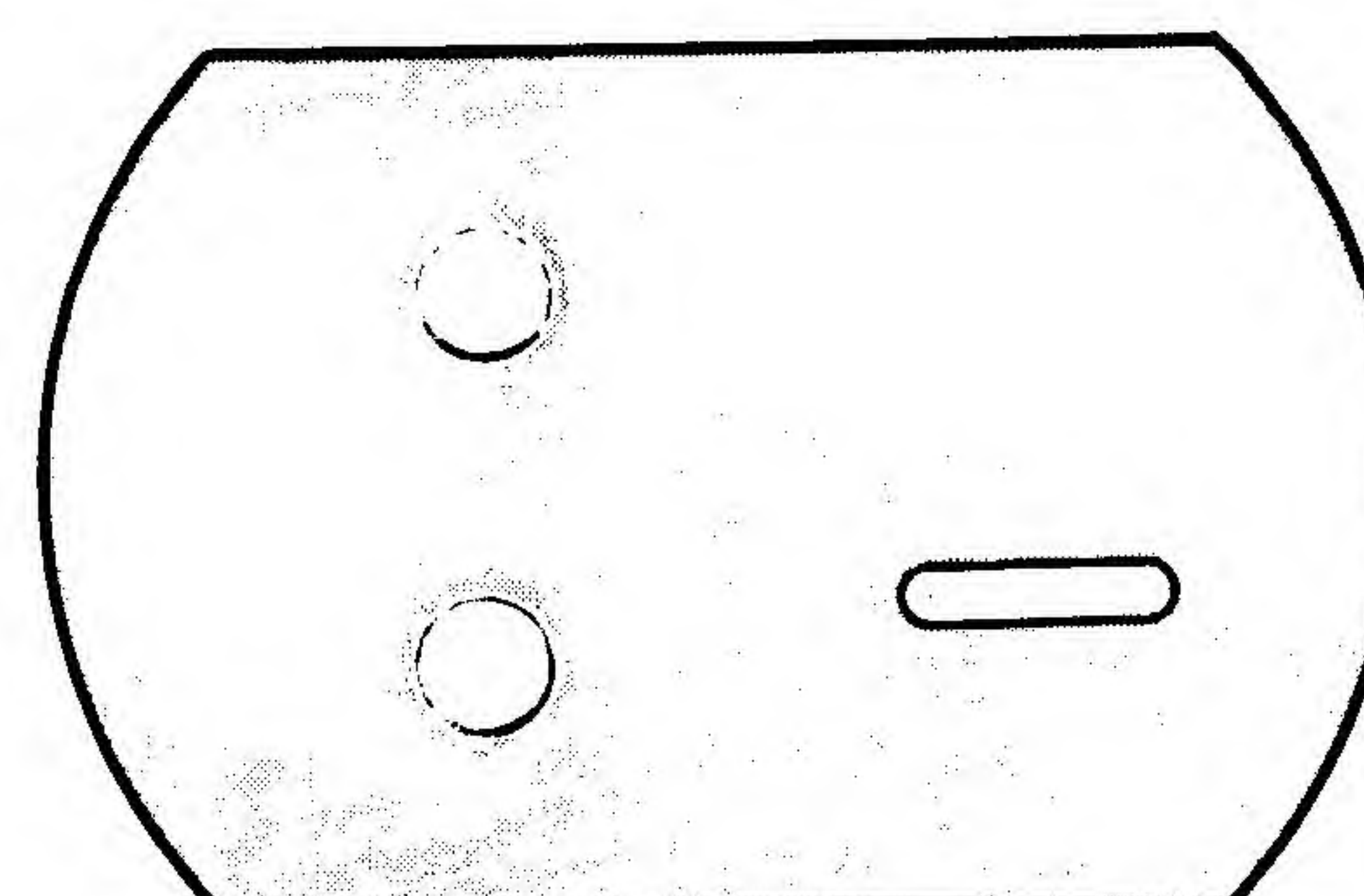
(B)

Oxide has Accumulated in the Pole Tip Area. Replace Drawer.



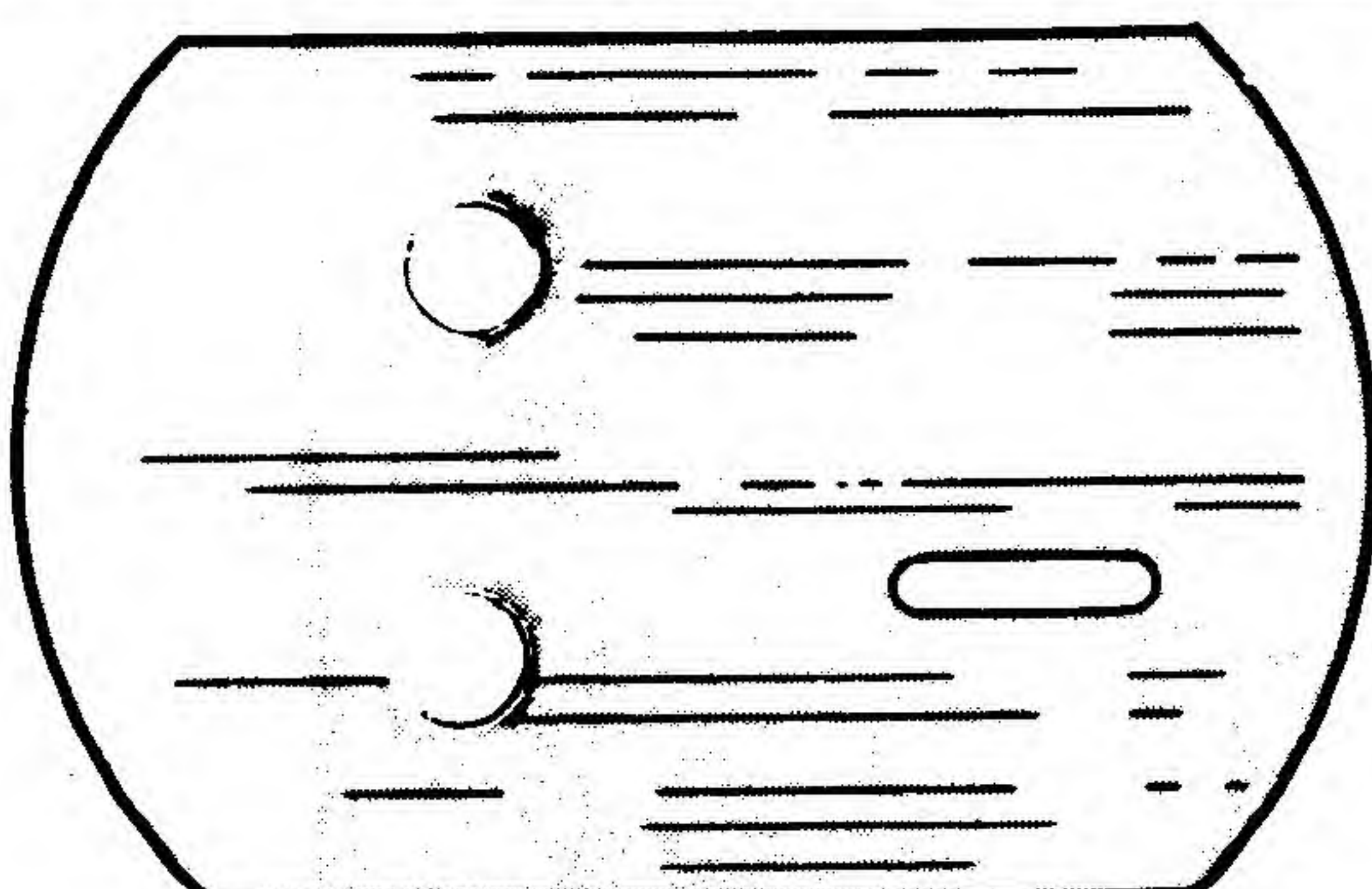
(C)

Alcohol Residue. Clean gliding shoe with 91% isopropyl alcohol. Remove alcohol with a lint free tissue using a gentle wiping motion. Do not allow alcohol to dry in small pools such that residue areas are formed.



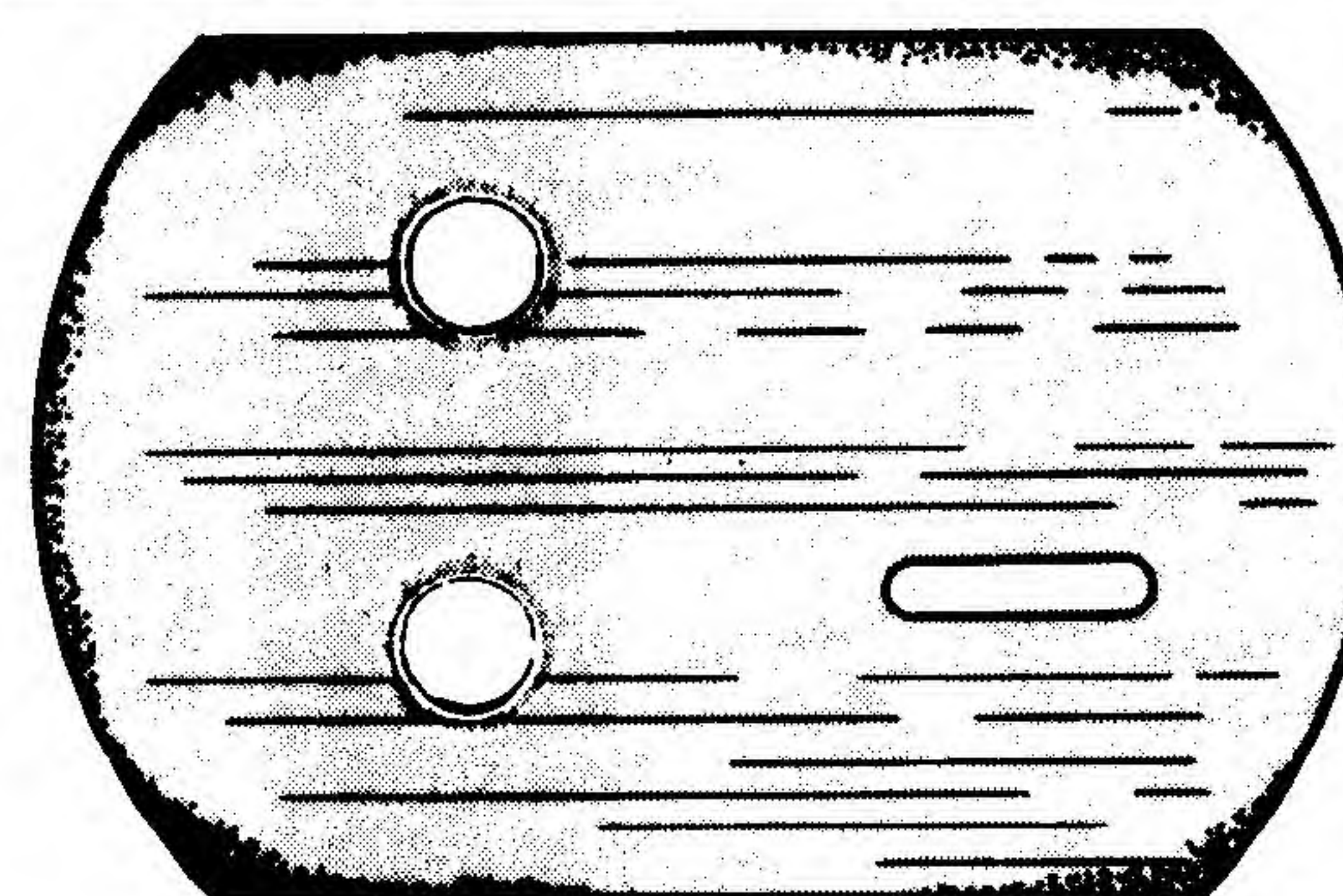
(D)

Finger Prints and other Oily stains. Oily stains provide an excellent means by which oxide may be transferred to the gliding head. Complete removal of the stain is necessary before resuming file operation.



(E)

Slight Scratches without Oxide Build-up. Drawer may be used.



(F)

Slight Oxide Build-up. Clean with 91% isopropyl alcohol. Drawer may be used.

Figure 3-24 Head Inspection

15556

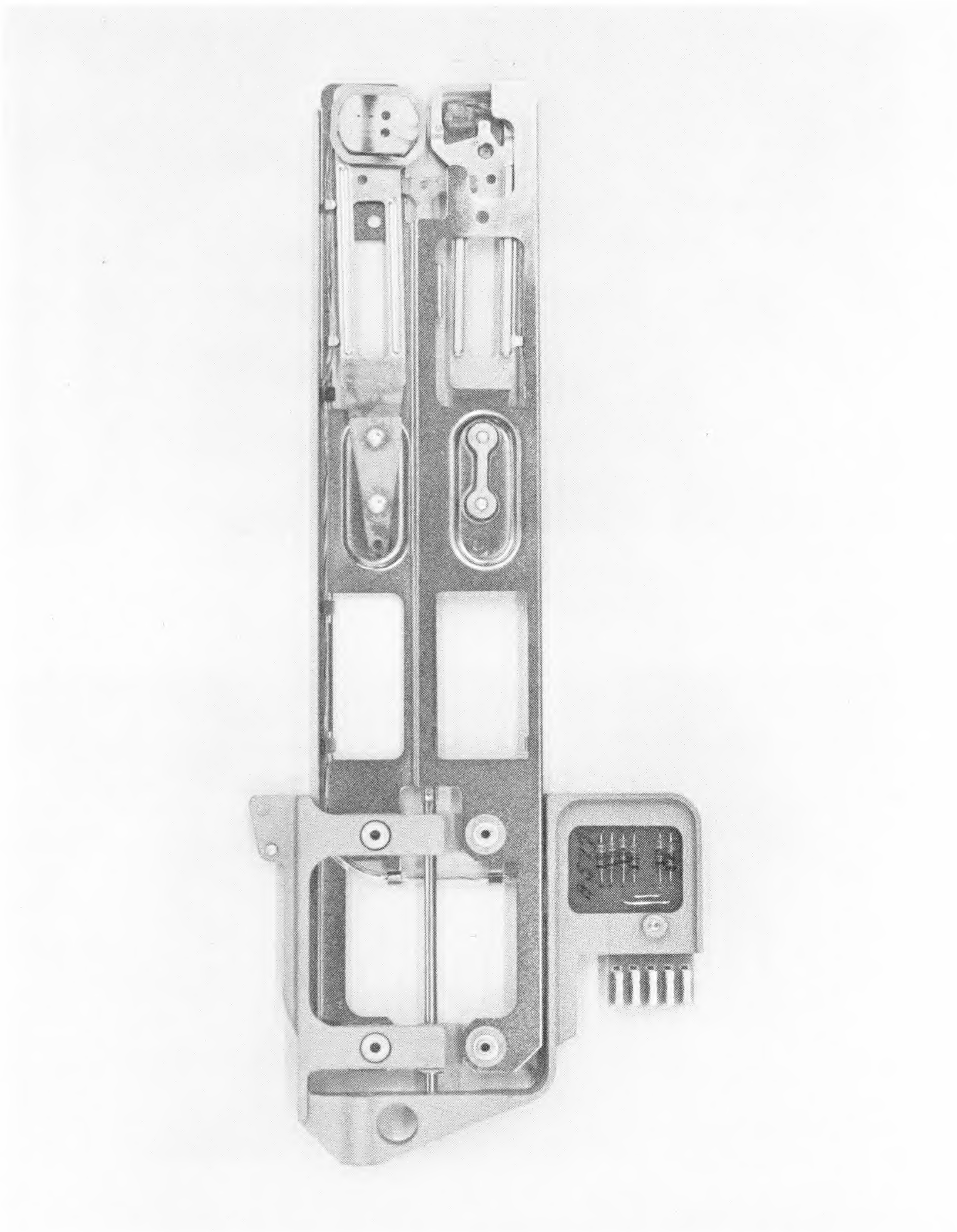


Figure 3-25 Drawer Assembly

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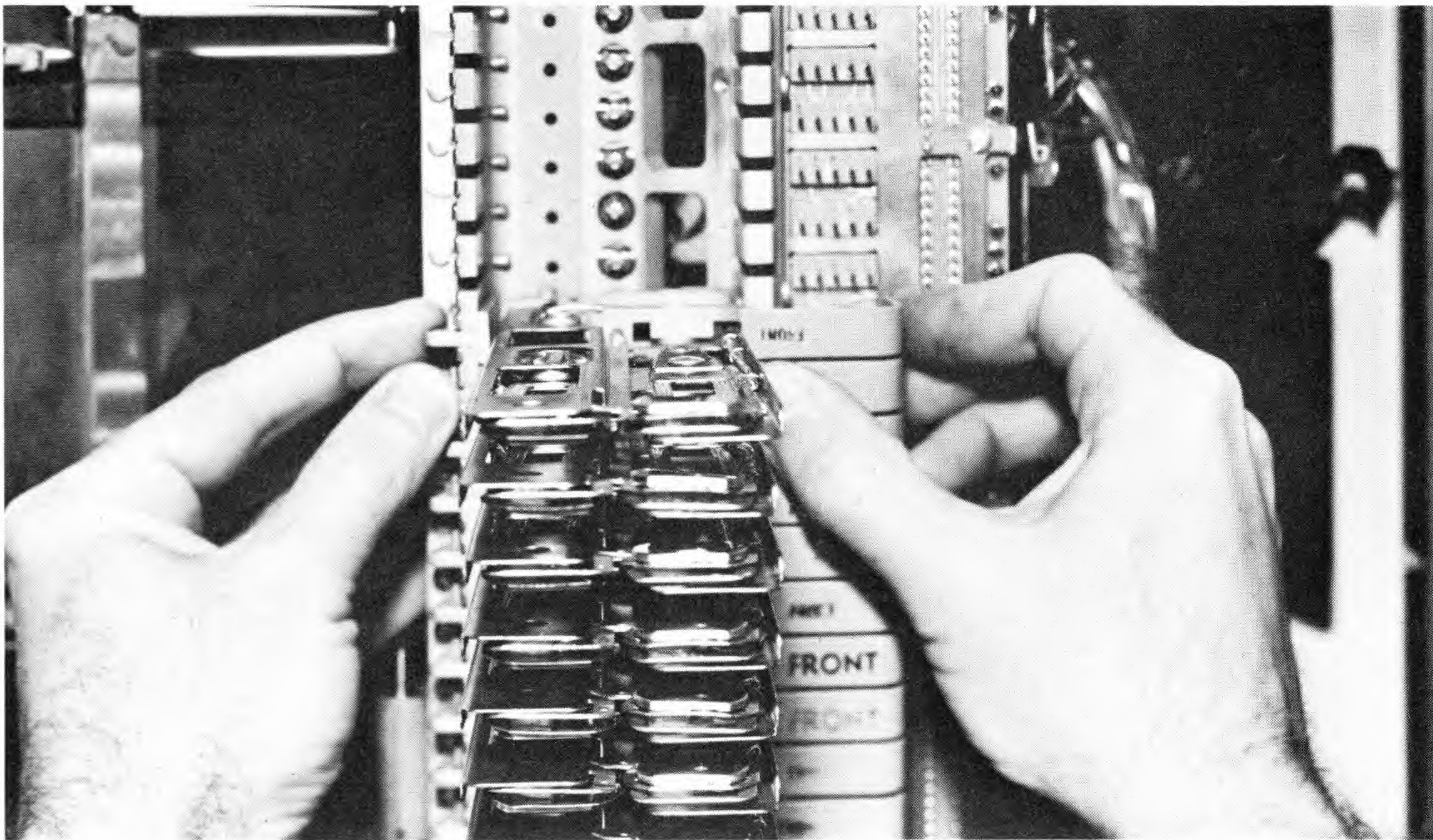


Figure 3-26. Drawer Removal

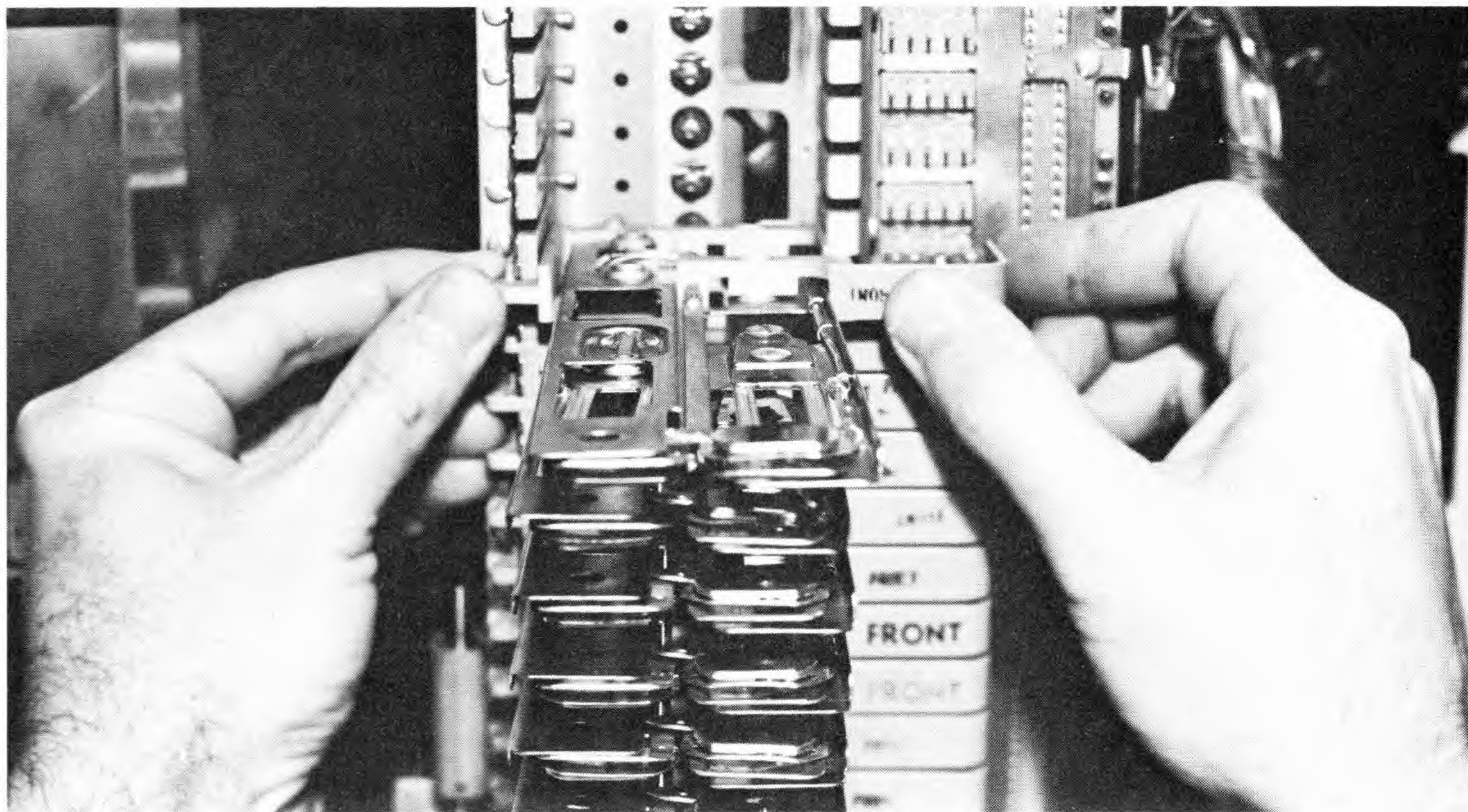


Figure 3-27. Drawer Insertion

Figures 3-28, 3-29, 3-30, (Deleted)

Visual Inspection (Figure 3-24)

Inspection and cleaning of heads can normally be made without removing the drawers from the receiver. However, if the condition of a head is questionable; remove the head from the receiver for inspection (see Drawer Removal Section 3.2.2.1).

Use the following criteria for determining the condition of a read/write head.

Give particular emphasis to these areas:

1. Oxide accumulation due to scratches and/or projections.
2. Oxide accumulation without scratches.
3. Scratches without oxide accumulation.

Scratches and Oxide Build-up. (A Figure 3-24). The degree to which a head is scratched is not necessarily the criteria for rejection. The amount and relative position of oxide build-up is much more significant. Scratches with oxide, are cause for rejection of the head. It may be necessary to remove the oxide to determine if a scratch has caused the build-up (see Head Cleaning).

Oxide Build-Up Without Scratches. Remove foreign material of any type from the gliding surface before resuming file operation. Provided no scratches occur in the oxide areas, and reused.

If oxide has accumulated in the pole tip areas (B Figure 3-24), the head should be replaced.

The radius around the entire perimeter of the shoe may pick up oxide during normal operation (F Figure 3-24) and although the oxide should be removed, it is no cause for concern.

Inadequate cleaning and/or operation in a contaminated atmosphere results in an unsatisfactory condition (C, D Figure 3-24). Contaminate removal is again essential prior to resuming file operation.

Scratches without Oxide Build-Up ((E) Figure 3-24). Scratches are permissible on the gliding surface provided that no oxide is present.

Cleaning

WARNING: Use 91% isopropyl alcohol (P/N 2155966) for disk and head cleaning. This cannot be purchased locally and should be ordered from Mechanicsburg, Pa.

CAUTION: Because this alcohol is flammable, it must be stored in a one gallon metal shipping container with the lid sealed when not in use.

Keep only a minimum quantity in the customer's office.

Heads can be easily cleaned without removing them from the receiver. If a drawer must be removed for cleaning, refer to Drawer Removal (Section 3.2.2.1). Clean heads as follows:

1. Wrap a piece of cleaning tissue (P/N 2108036) around the head cleaning paddle (P/N 2108474).
2. Moisten the cleaning tissue with alcohol (P/N 2155966) and remove any foreign material on the shoe face. Use as little pressure as possible to prevent permanent deformation to the drawer assembly while cleaning.

WARNING: No water marks from the alcohol or fingerprints should be on the gliding surface after cleaning.

3.2.3 SWING-OUT INTERLOCK MICROSWITCH

Adjustment

Adjust mounting bracket so microswitch is made by the drawer retaining pin when receiver is closed and locking pins are seated (Figure 3-16).

WARNING: Do not over adjust bracket. Abnormal pressure is required to engage receiver locking pins if this bracket is over adjusted.

3.3 CLOCK HEAD

WARNING: Do not check continuity of the clock head while the head is loaded. If continuity of the clock head is checked with the head loaded, the clock track can be erased. The potential of a VOM is sufficient to erase the clock track.

The DC Resistance of the clock head should measure approximately 4 ohms.

Service Check

The amplitude of the clock-head signal should average 2.0 to 2.5 volts peak-to-peak minimum for any ten-cycle period. This should be measured at the output of the second linear amplifier with a CA preamplifier added algebraically. The average envelope of the clock signal should be 8 to 10 volts.

six (640 kc) clock tracks each are recorded at intervals marked on the clock indexing plate (Figure 3-31).

The 640 kc clock tracks have 21,510 cycles.

Each clock track must match the other tracks, cycle for cycle, except at the leading edge of early index time.

The last pulse of all clock tracks must close at the leading edge of early index within plus or minus 36° of an in-phase condition with the first pulse.

3.3.1 CLOCK HEAD AS AN ASSEMBLY (Figure 3-31)

Adjustment

1. Attach oscilloscope as in the service check.
2. Loosen locking screw.
3. Turn adjusting screw in or out to obtain maximum signal.

NOTE: IBM #6 oil may be used on the rails to facilitate moving head assembly. See Clock-Head lubrication chart (Figure 2-4).

Removal

1. Turn off all power.
2. Detach cable at plugs G01 and G02. Allow disks to stop rotating.
3. Adjust clock head as far forward as possible and remove rear mounting screw.
4. Back off clock head to its rearmost position and remove front mounting screw.
5. Lift clock-head assembly off locating pins, being careful not to damage disk. A folded IBM card can be placed over the clock disk with the lower flap between the disk and the clock head to protect disk.

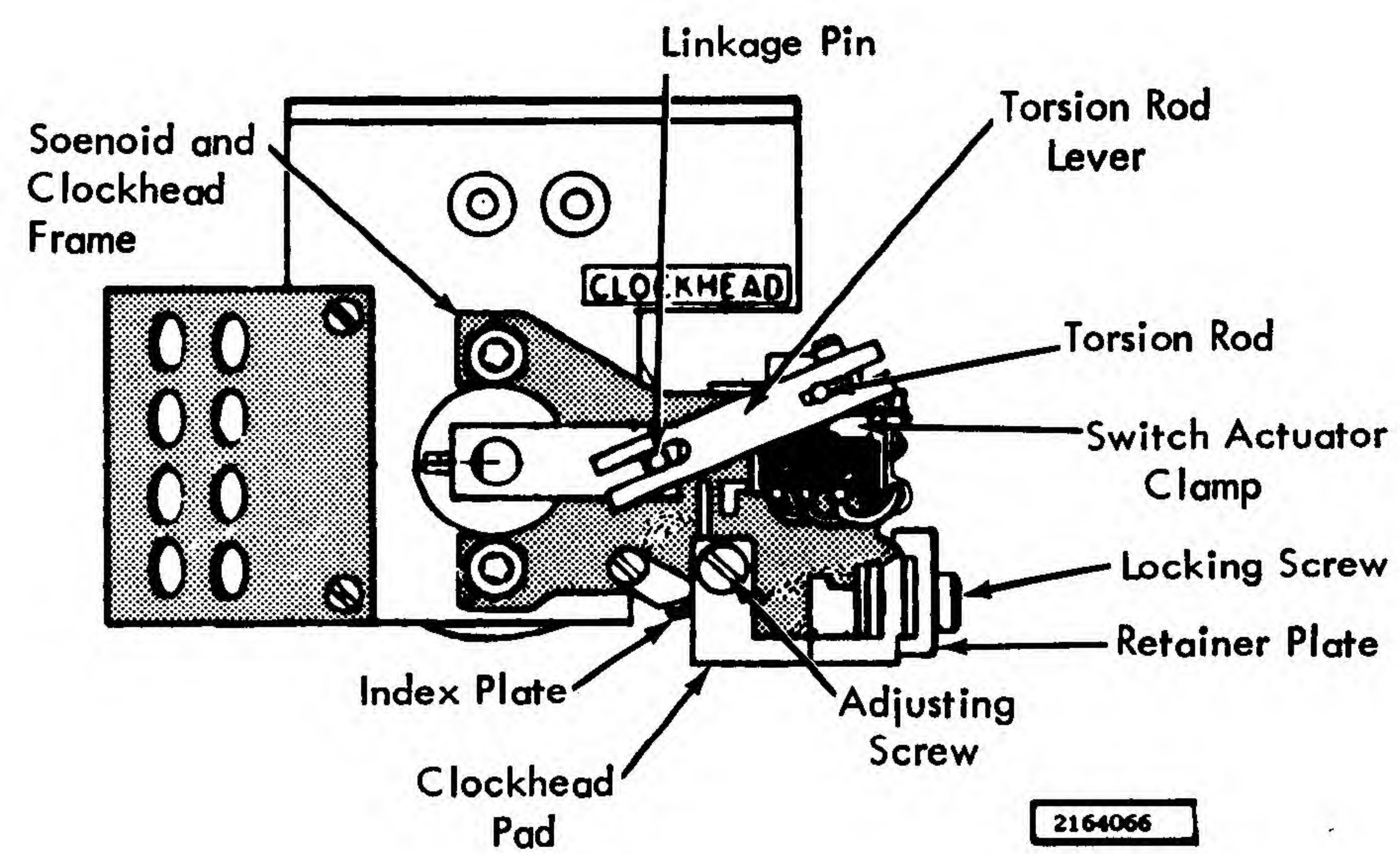


Figure 3-31 Clock Head Assembly

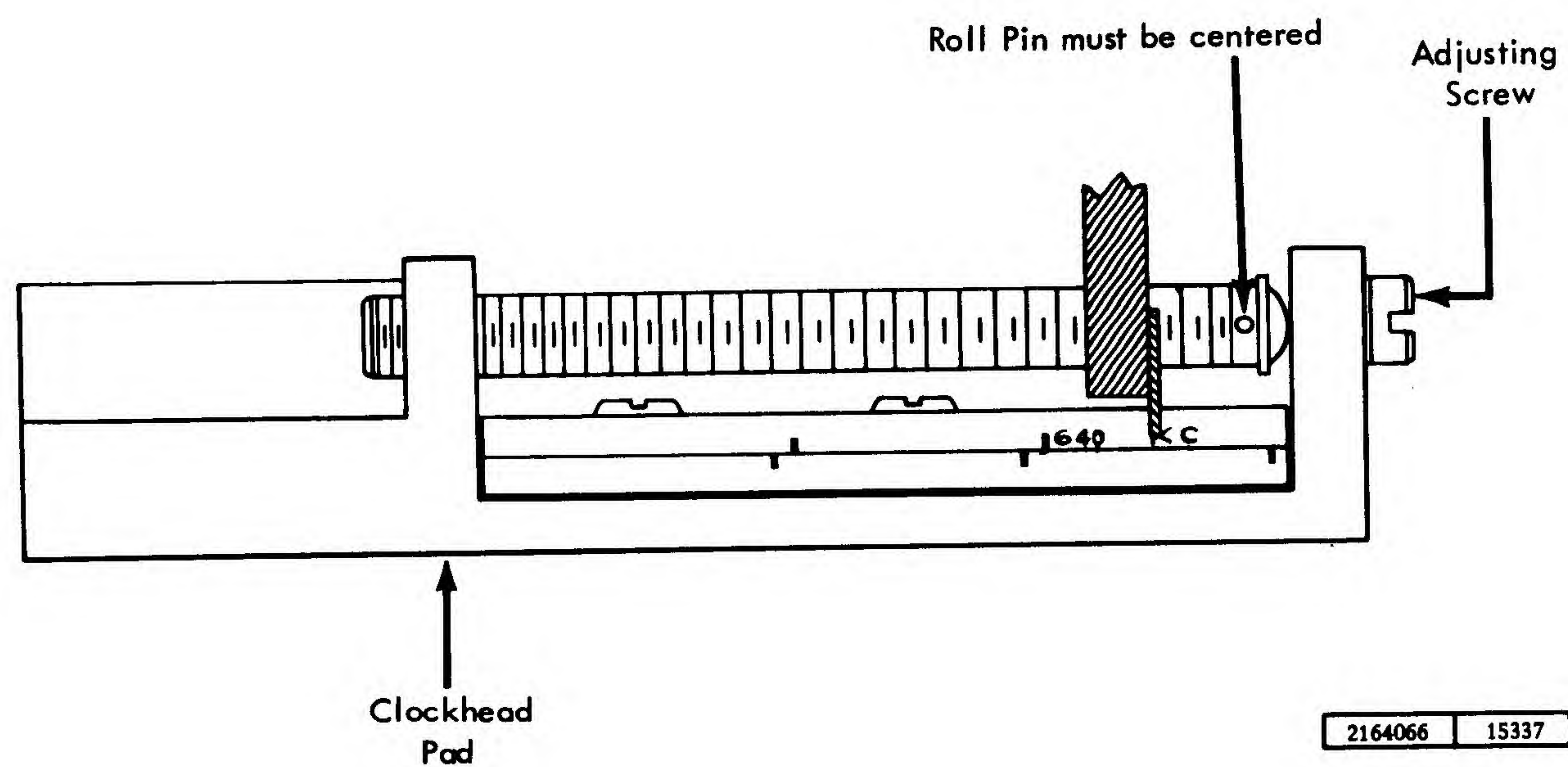


Figure 3-32 Clock Head Adjustment

Replacement

1. Check plastic shim for damage and replace if necessary. Clean mounting pad of chips and dirt before replacing shim.
2. Replace clock head assembly by slipping over locating pins. By means of the adjusting screw (Figure 3-32), adjust clock head as far in as possible and install rear mounting screw. Check for proper head to disk clearance (0.080" + 0.020"). Back off clock head to extreme out position and install front mounting screw.
3. With an ohmmeter, check the resistance between the clock-head support and the machine frame. This should exceed 2 megohms.
4. Attach cable at plugs G01 and G02.
5. Perform Clock-Head Service Check. Adjust if necessary.

NOTE: The clock-head loading mechanism is pre-adjusted at the plant and should require no further attention, but failing to obtain the required signal, the following adjustment can be made.

With solenoid energized and head loaded, the torsion rod lever (Figure 3-31) should be clamped on the torsion rod in such a position that 260 + - 10 grams are required at point "x" to lift the torsion rod off the linkage pin (switch should not be actuated during this time). Adjust switch actuator clamp to close switch when head is properly loaded.

3.3.2 CLOCK-HEAD ARM ASSEMBLY (Figure 3-33)

Removal

1. Disconnect cable assembly to G01 and G02.
2. Disconnect jack leads.
3. Remove three mounting screws.
4. Lift arm assembly from locating pins and at the same time move the head down and toward the electronic frame to free the arm from the torsion spring.

Replacement

1. Engage arm into the torsion spring and into the locating pins.
2. Attach ground lead and secure mounting screws (4 to 6 in-lbs.).
3. Connect cables G01 and G02.

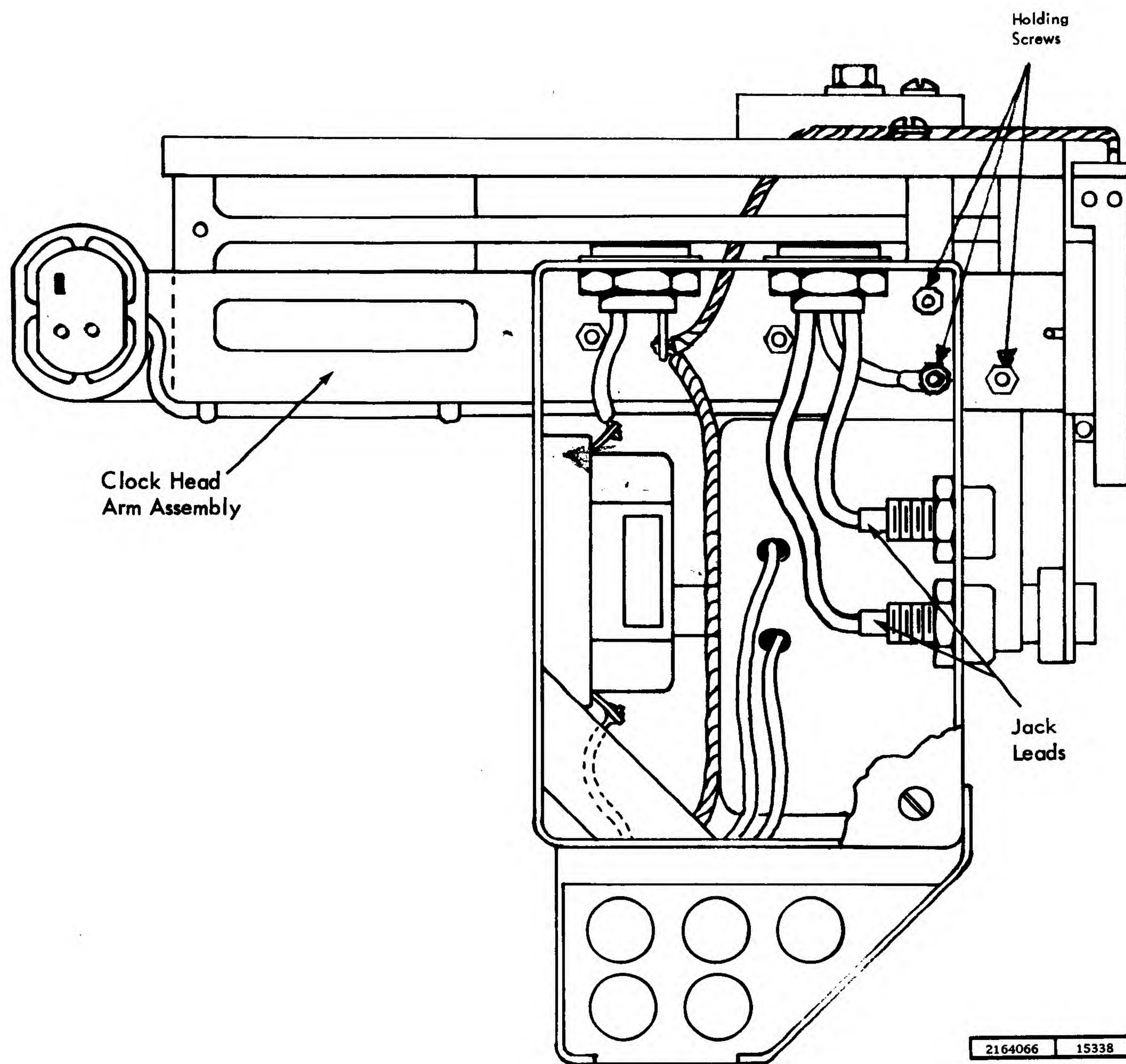


Figure 3-33 Clock Head-Arm Assembly

4. Check torsion spring for proper engagement.
5. Check head loading and unloading.

3.4 HYDRAULIC ACTUATOR

NOTE: After data has been written on discs, any adjustment of the actuator flex rods, yoke screw, and flex rod nuts requires that all tracks covered by that actuator be read out before adjustments are made and then subsequently rewritten. From this it, of course, follows that actuator replacement and drag adjustments also require readout and rewrite. If readout cannot be made because of a defective actuator, use replacement actuator to readout by peaking on track signals with oscilloscope and yoke adjustment screw. Because of the required readout and rewrite, adjustments as mentioned above should not be made unless some indication of trouble warrants it.

CAUTION: Any time maintenance is to be performed around an actuator with power on, the access mechanism must be set INOP and the safety circuits which hold the actuator output shaft detented (while the access cover door is removed) must be checked at least once for correct operation before proceeding.

This safety check is accomplished as follows:

1. Set the desired access INOP.
2. From the CE panel, reset rezero.
3. Set in an address of 200 cylinders.
4. Check rezero operation by setting rezero. Check that the detent holds about 1 second while address clears, and is followed by a slow return of carriage to outer limit stop.
5. Reset rezero and set in an address of 20 cylinders.
6. Remove access cover. This should cause rezero to come on. The cylinder address should clear, and the detent should hold.

For the first second after removal of the cover, the detent will be held, even if the switch is bumped. After that, when the switch is bumped or depressed, the carriage will return toward the outer limits at rezero force, but only while the switch is closed. When it is released the detent will drive in and hold.

7. With cover off, try to reset rezero from CE panel. Try to set a new address. Both should be impossible. Check an address of over 200 cylinders in the same manner. (Dropping of the piston adders will cause slight movement of the carriage.)
8. After safety check is made, set access to the desired location and proceed.

CAUTION: Although the actuator is electronically interlocked when the access-cover door is open, the actuator may attempt to move under hydraulic pressure if solenoid DC power goes off for any reason.

Service Checks (See NOTE under 3.4 HYDRAULIC ACTUATOR)

Gib Adjustment. Stabilize oil temperature in actuator by random accessing actuator on fast oscillator for half hour (minimum) (or use remote CE box in Seek Repeat mode -- set one address in switches on CE panel; Set second address in Remote CE box.) prior to gib adjustment (see Section 3.4.1.1). With ways properly lubricated with IBM #6 oil, flexure rods disconnected, disks rotating, and heads loaded, the moving drag of the carriage must be 3 \pm 1 lbs at 4 to 8 inches per second velocity.

Removal (Figure 3-34)

1. If possible, read the data from all the disks serviced by this actuator. Store this data so it can be rewritten after the actuator is replaced.
2. Remove receiver assembly including electrical cables. All power should be off and disks stopped (see Receiver Removal).
3. Disconnect the following four electrical connectors to actuator:
 - a. One on actuator lid.
 - b. One for motion transducer.
 - c. One to limit stop plate and switch assembly.
 - d. One to head load, head unload, and swing-out interlock switches and remove wires from pins "P", "M", and "R".
4. Disconnect bleed line from actuator lid and install cap (P/N 2121687) on nipple.

WARNING: Do not start hydraulic power supply with bleed line disconnected.

5. Unlock and back off radial positioning screw.
6. Disconnect pair of hydraulic lines located at back of actuator housing by loosening retaining screw between lines. Catch oil drippings with absorbent cloth or paper. Wrap quick-disconnect with lint free tissue.
7. Remove actuator by removing four actuator mounting screws. This step requires two people. With actuator resting on

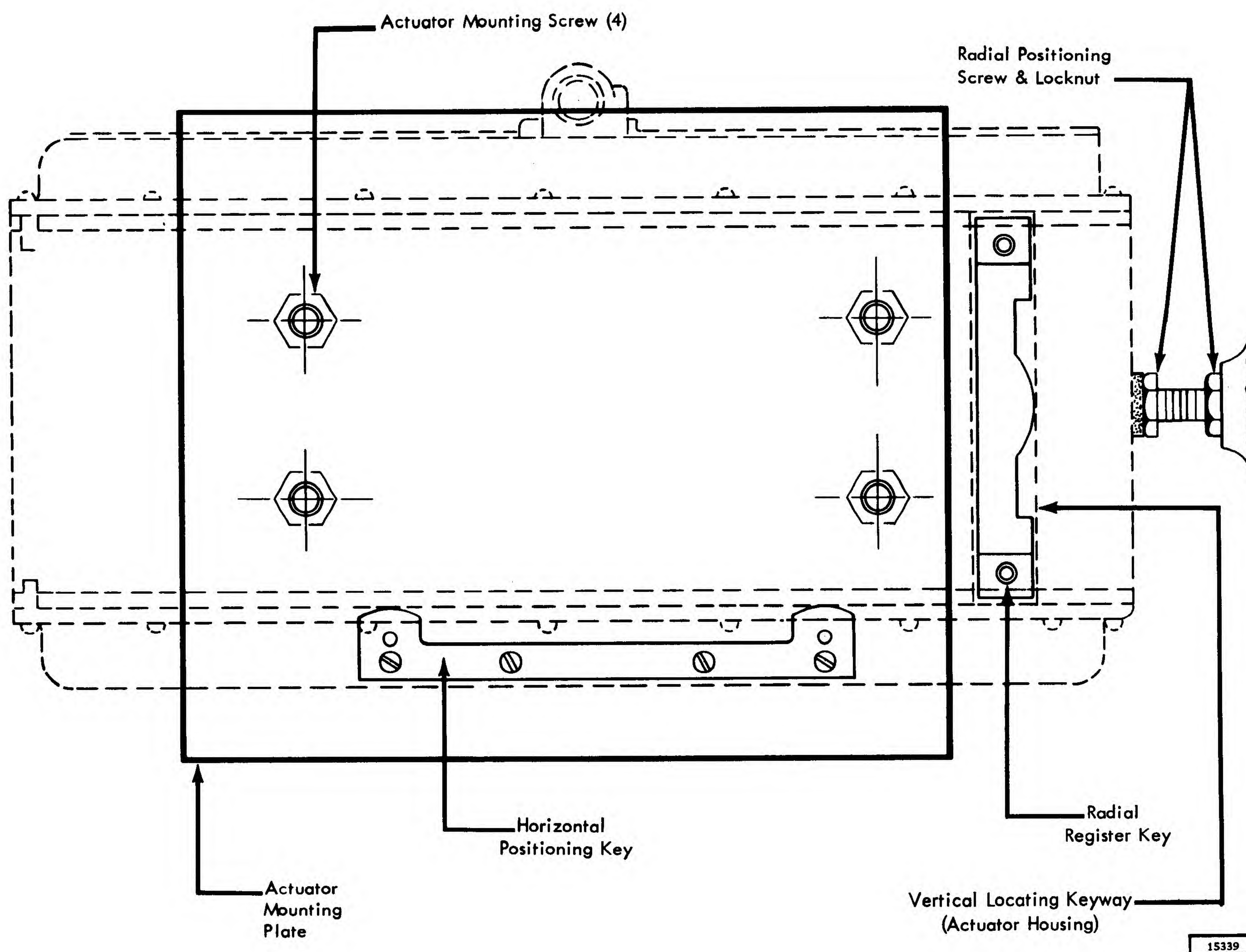


Figure 3-34 Radial and Horizontal Positioning Keys

Figures 3-35, 3-36, 3-37, (Deleted)

horizontal positioning key, unit must be held against mounting plate, while screws are being removed. Be certain that two men lift actuator off positioning key. The actuator weighs about 60 pounds.

8. Push carriage fully forward.
9. Remove swing-out interlock switch, cable, and clamps.

Replacement

1. Clean actuator mounting surfaces.
2. Make sure that actuator fittings are clean. Do not remove protective caps of new actuator until ready for connection to hydraulic lines.
3. Mount actuator on mounting plate. (This step requires two people.) Make sure that actuator is resting on horizontal positioning key, and that vertical locating keyway is straddling radial register key.
4. Insert and finger tighten four mounting screws.
5. Torque radial positioning screw to 25" lb + 2" lb. and lock with lock nut. Because of the arm leverage of the actuator-torquewrench adapter (P/N 2108436), the actuator-torque wrench (P/N 2108435) must be set for 12" lb.

WARNING: The actuator housing can be damaged in the area where the housing is positioned against the radial locating key if excessive torque is applied to the radial positioning screw. To eliminate the possibility of damaging the actuator housing, the radial positioning screw should be torqued to a setting of 12" lb. at the wrench dial, when using the torque wrench and adapter. Exercise caution to assure that the wrench is used in the direction which snaps to indicate proper torque (wrench is solid in opposite direction).

6. Torque actuator mounting screws (4) to 75 + - 5 inch pounds.
7. Remove caps from new actuator.
8. Connect two hydraulic lines, one bleed line and three electrical connectors.
9. Replace Receiver assembly (see Receiver Replacement).
10. Check carriage gib adjustment, yoke inner limit stops, and inner and outer limit switch adjustments (see Limit Switches).
11. Rewrite all disks serviced by the replaced actuator.

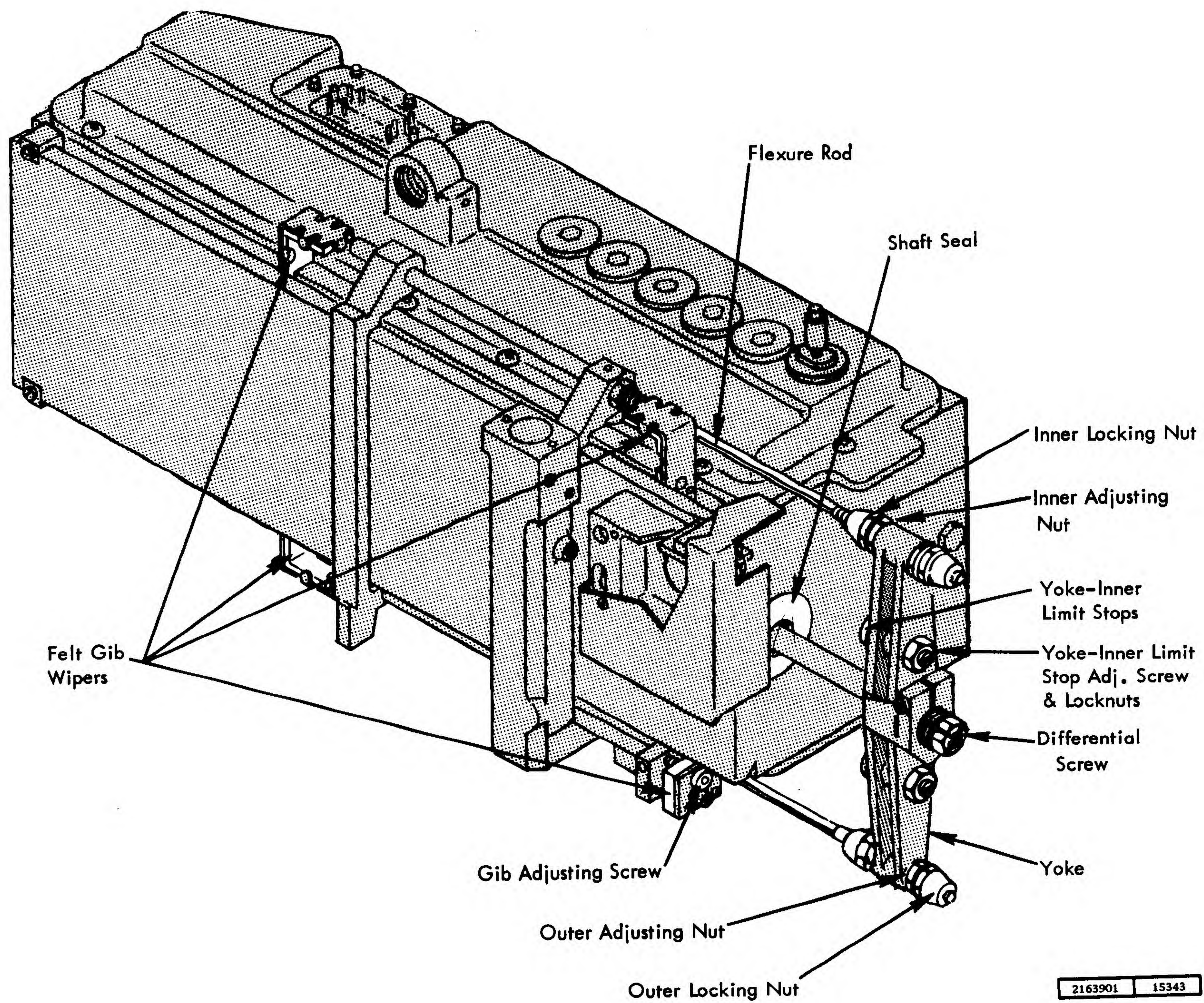


Figure 3-38 Carriage Components

3.4.1 ACTUATOR CARRIAGE

3.4.1.1 Carriage Gib (Figure 3-38)

The carriage gib and the actuator housing ways are a matched set, lapped for maximum sliding surface contact with minimum friction. Gib adjustment is provided only to compensate for wear.

Adjustment

Because this procedure requires reading out and rewriting the data, this adjustment should be made only when a problem arises that indicates that the drag may be incorrect.

The carriage gib adjustment can be accurately checked and corrections made only when machine is at operating temperature and disks are rotating at maximum speed.

1. Read data from all disks serviced by this actuator. Store this data so it can be re-written after the gib is adjusted.
2. Properly lubricate ways with a light film of IBM #6 oil.
3. Load the heads.
4. Disengage yoke assembly from both flexure rods by removing outer flexure rod locking nuts and adjusting nuts. Do not disturb setting of inner flexure rod locking nuts and adjusting nuts.
5. Check the gib for a 3 lb. + 1 lb. moving drag of the carriage. Check this moving drag at 4" to 5" per second velocity with the actuator housing at operating temperature after accessing on the fast oscillator for at least one-half hour.

Check this adjustment at area of way on which actuator carriage operates:

- a. Outer surface on front actuator.
 - b. Inner surface on rear actuator.
6. Move carriage assembly slowly and smoothly between inner and outer limit stops. No binds of any nature must exist. Static (break-away) friction of from 6 to 8 lbs. is considered normal.
 7. If the conditions in step 5 or step 6 are present, go directly to step 11. If these conditions are not present, proceed with step 8.
 8. Free locking nut for adjusting screw.
 9. Turn adjusting screw until conditions in step 5 and step 6 are satisfied. A clockwise movement of the adjusting screw

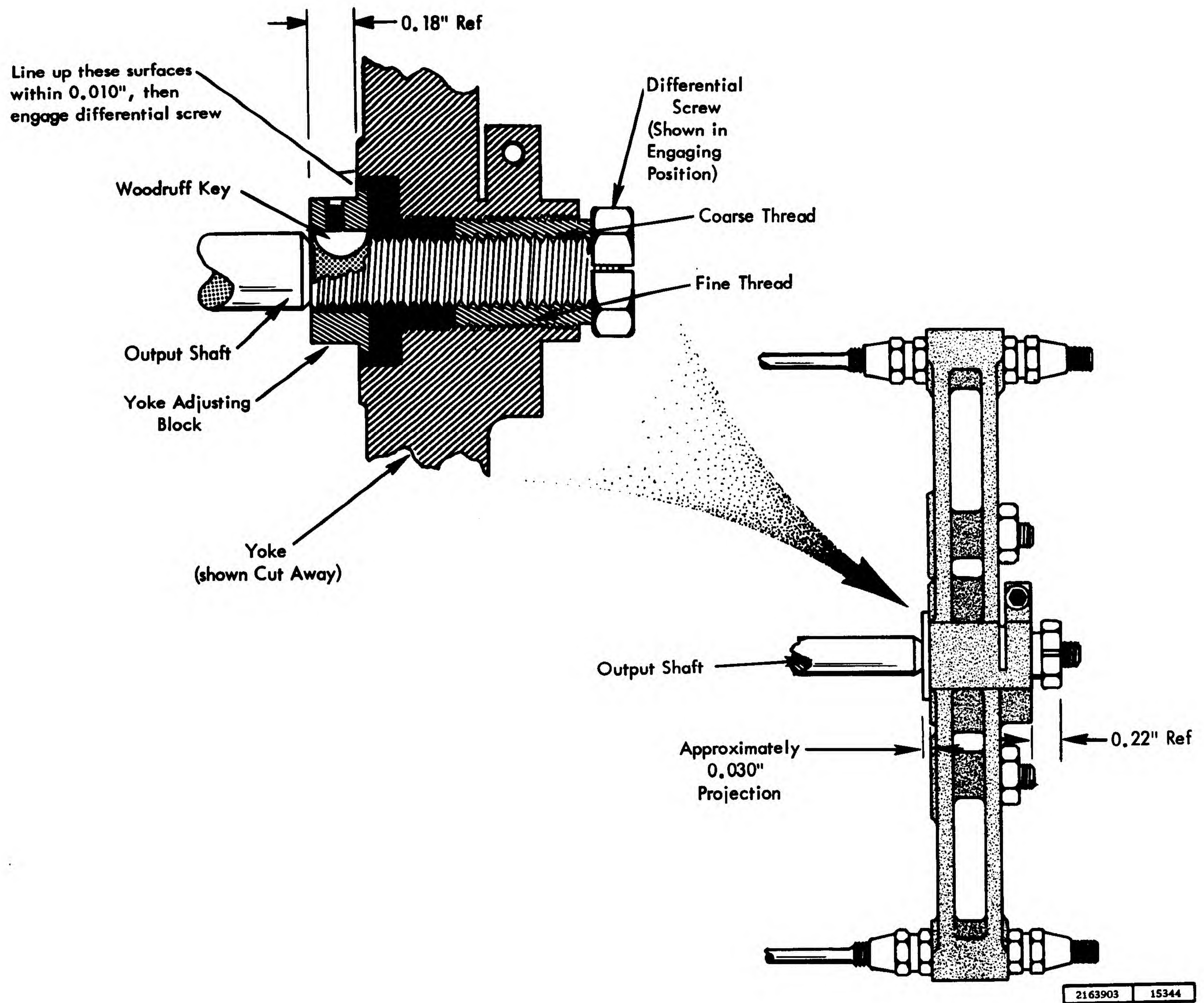


Figure 3-39 Yoke Adjustment

tightens gib and counterclockwise motion loosens gib.

10. Secure locknut for adjusting screw.
11. Attach yoke to flexure rods and replace outer flexure rod adjusting and locking nuts.
12. Rewrite all disks serviced by the readjusted actuator.

3.4.1.2 Yoke Assembly (Figure 3-39) (See NOTE under 3.4 HYDRAULIC ACTUATOR)

The yoke assembly is connected to the actuator output shaft through the use of a differential screw. The differential screw facilitates accurate positioning of the read/write head with respect to previously written information. It is important that the yoke adjusting block projects equal amounts at top and bottom.

Adjustment

1. This adjustment is normally required only to pick up previously written data after actuator or carriage component replacement. Loosen locking screw until the differential screw just turns freely with a wrench.
2. Monitor head 20 on oscilloscope and turn differential screw until maximum head signal amplitude is obtained.
3. Tighten locking screw.

Removal (Figure 3-40)

1. While power is still on, if possible, read out data; if not possible, position head at cylinder "0" and:
 - a. Measure and record space between actuator outer limit stop and carriage limit stop. This should be 0.076" ± 0.002 ", -0.001".
2. Remove electrical power to machine.
4. Remove actuator shield door.
5. Remove nuts holding yoke to flexure rods.
6. Loosen yoke locking screw.
7. Remove differential screw.
8. Remove yoke and adjusting block from output shaft.

Replacement (Figure 3-39)

1. Install yoke adjusting block on output shaft.
2. Align machined edge on yoke adjusting block with yoke inner face and carefully engage differential screw. This is to obtain proper relationship for coarse and fine thread engagement.
3. Turn differential screw until yoke adjusting block projects approximately .030" from yoke.
4. Tighten yoke locking screw.
5. Attach yoke to flexure rods.
6. Push carriage in against inner limit stop and start file.
7. If data was not read out, detent output shaft at cylinder zero and adjust space between actuator outer limit stop and carriage limit stop to value obtained in step 1a of removal procedure. If data has been read out, adjust space between actuator outer limit stop and carriage limit stop to 0.076" + 0.002" -0.001".
8. If data was read-out before yoke was removed, rewrite all surfaces serviced by this activator. If data was not readout, monitor head 20 output on an oscilloscope and by means of differential screw, position carriage for maximum signal amplitude at cylinder zero (see Yoke Assembly Adjustment). Read out module and rewrite., after setting .076 dimension.

3.4.1.3 Yoke Inner Limit Stops (Figure 3-41)

Two adjustable plastic pads are provided on yoke assembly. These pads provide a cushioning effect if the carriage overtravels.

Adjustment

1. Rear Actuator.
 - a. Detent rear actuator at track 250.
 - b. Adjust crash-pad stop adjusting screws to obtain 0.015" to .020" (metal to plastic) clearance between actuator housing and crash-pad stops on yoke.
 - c. Tighten lock nuts.

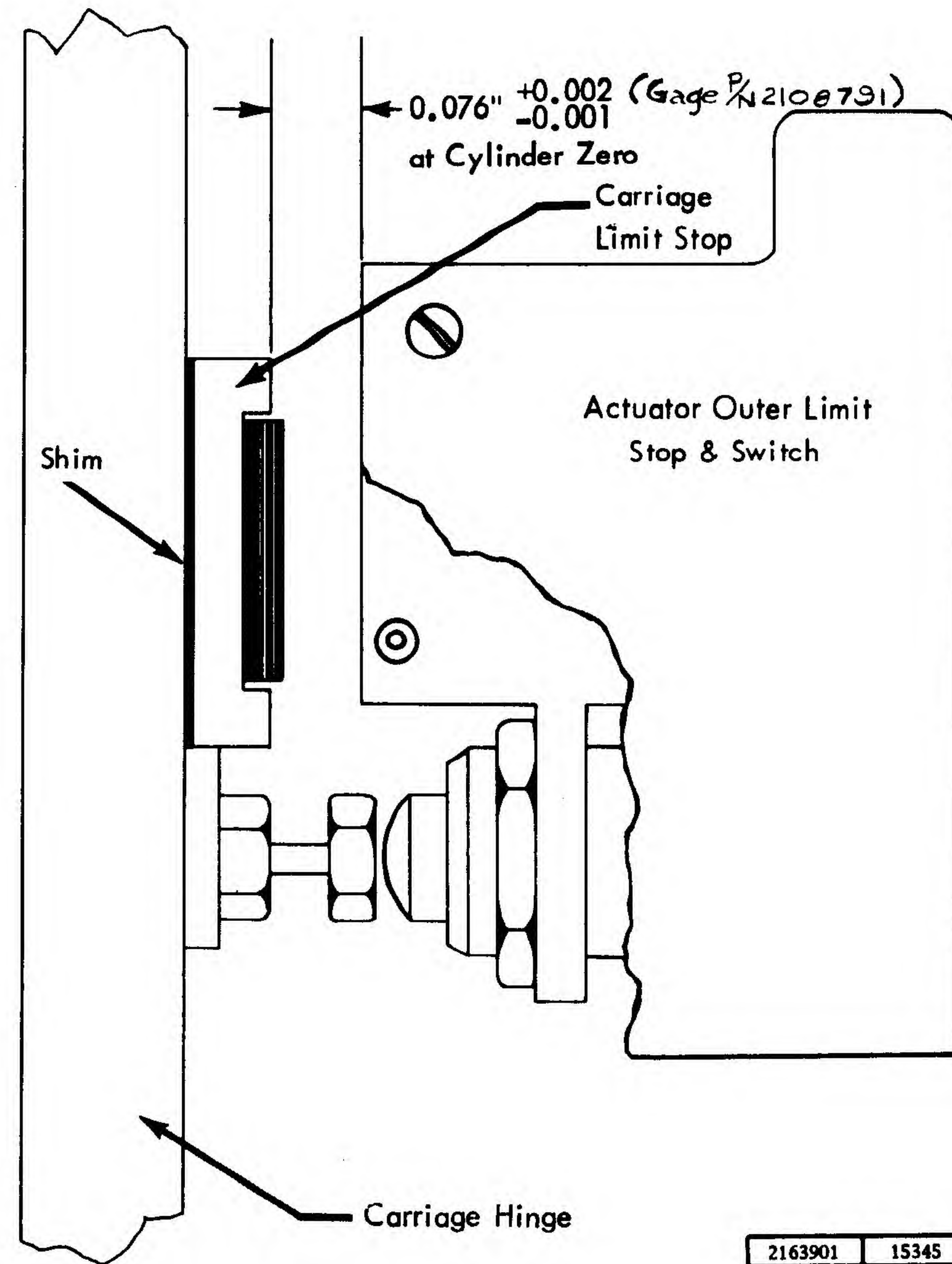


Figure 3-40 Carriage Outer Limit Stop and Switch Adjustment

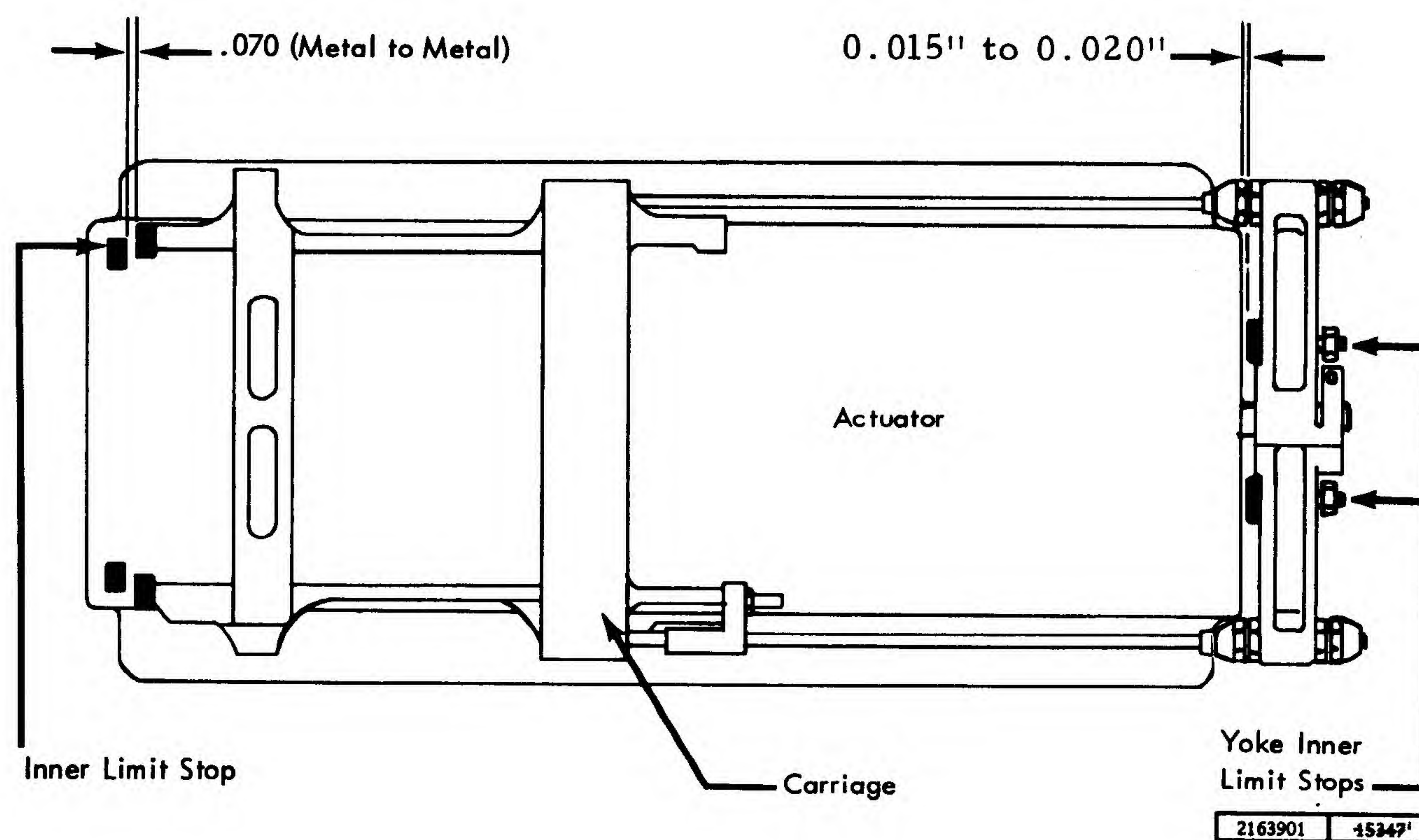


Figure 3-41 Yoke Inner Limit Stop Adjustment

2. Front Actuator

- a. Detent front actuator at track 250.
- b. Position inner limit crash-pad stops to obtain 0.015" to 0.020" between the actuator housing and crash-pad stops on yoke.
- c. Tighten lock nuts.

Note: Any yoke adjustments will require readjusting of the yoke limit stops.

3.4.1.4 Outer Limit Stops

Service Check

1. Position access at cylinder "000" by addressing actuator to track "000".
2. Check metal to metal spacing between carriage limit stop and actuator outer limit stop. Spacing should be 0.076" +0.002" -0.001".

Adjustment (see note under 3.4 Hydraulic Actuator)

1. Position actuator at cylinder "000" by addressing actuator to track "000".
2. Loosen differential screw.
3. Place a 0.076" (P/N 2108791) shim between stops (Figure 3-40), and adjust differential screw as required.

3.4.1.5 Carriage Flexure Rods (Figure 3-38)

Motion is transmitted to the carriage from the actuator through its output shaft and the yoke assembly. The carriage is attached to the yoke by means of two flexure rods. It is important that the force presented by the output shaft be evenly distributed between the two flexure rods. The front flexure rods are 2 1/2" shorter than the rear flexure rods.

Adjustment (should be made only when yoke or flex rods are replaced and prior to rewriting file)

1. Read out module if possible.
2. Position heads at cylinder zero.
3. Loosen outer and inner flexure rod locking and adjusting nuts.
4. Place a .076" shim between carriage limit stop and actuator outer limit stop (see Figure 3-40).
5. Rotate inner flexure rod adjusting nuts until they meet inside face (top and bottom) of yoke assembly simultaneously.
6. "Snug up" outer flexure rod adjusting and locknuts. Care must be taken to avoid putting a torsional strain on actuator output shaft.
7. Without disturbing setting of inner flexure rod adjusting nuts, tighten their respective locking nuts.
8. Rewrite module.

3.4.2 LIMIT SWITCHES (FIGURE 3-42)

The inner and outer limit switches indicate extremities of carriage travel (inner CE cylinder and rezero position). They are located on the actuator limit stop and switch plate assembly. They can be checked and adjusted only after the carriage gib, yoke assembly, and flexure rods are in correct adjustment.

3.4.2.1 Inner Limit Switch

Service Check

The inner limit switch must be made when the carriage is at cylinder 250 and not made when the carriage is at cylinder 249. Check switch operation by alternately setting in the two addresses from the CE panel and observing the CE cylinder indicator.

Adjustment

1. Disable rezero circuitry by removing SMS Card at 4/6A21.
2. Remove the Access cover door. Hold the cover switch by hand. Do Not tape the cover switch so it is inoperative.

3. Seek to cylinder 249.
4. Insert an .008" shim between the end of the adjusting screw and armature of the Inner Limit Switch. The Limit Switch light on the CE Panel should be ON.
5. Insert a .005" shim in place of the .008" shim. The Limit Switch light should not be on.
6. The conditions of both Items 4 and 5 must be satisfied. Failure of either test indicates need for adjustment. If the need for adjustment is indicated, proceed as follows:
7. Release the cover switch. Loosen the lock nut on the adjusting screw. Adjust as indicated in results of test of Items 4 and 5. Tighten lock nut.
8. Recheck Items 4 and 5. Hold cover switch by hand and seek to cylinder 249.
9. When Items 4 and 5 are both satisfied, replace access cover door.
10. Seek to Cylinder 250. The Limit Switch light should be ON. Reset to Cylinder 000 then 250 several times. Check that the Limit Switch light comes ON each time.
11. Seek to Cylinder 249. The Limit Switch light should not be ON. Reset to 000 then 249 several times. The Limit Switch light should never come on.
12. Remove Access Cover door, hold cover switch by hand. Seek to Cylinder 249.
14. Manually operate the Inner Limit Switch momentarily. The access should rezero. Replace access cover door.
15. Remove the fuse from any glob, 10 through 100. Seek to Cylinder 250. The access should rezero when the set button is released.
16. Replace fuse removed in Item 15. Seek repeatedly to Cylinder 250. The access should not rezero.
17. Seek repeatedly to Cylinder 249. The access should not rezero.

3.4.2.2 Outer Limit Switch

Service Check

This switch must be operated when the carriage is in the rezero position and not operated when it is in cylinder zero position.

1. Alternately set rezero and reset the access register from the CE panel and observe that the limit switch indicator comes on only when the actuator is in the rezero position.
2. Set cylinder 249 into the access register switches and alternately set and reset the access register. There should be no limit switch indication. A limit switch indication at this time indicates an incorrectly adjusted switch or excessive overtravel of the carriage.

Adjustment (Figure 3-42)

The outer limit switch is set by means of the adjusting screw on the carriage outer limit stop:

1. Reset the access register (Detent at cylinder zero).
2. Loosen locknut on carriage outer limit switch adjusting screw.
3. Place 0.024" feeler gage between adjusting screw and switch.
4. Rotate adjusting screw until switch just operates. This can be determined by observing the CE cylinder indicator.
5. Remove 0.024" feeler gage and place 0.015" feeler gage between adjusting screw and switch. Switch should close with 0.024" but not close with 0.015".
6. Tighten locknut on adjusting screw and recheck switch with feeler gages.
7. Repeat Service Check.

3.4.3 DETENT SAFETY TRANSDUCER

Service Check

When accessing 100 cylinders or more, the motion transducer output should be 0.9 v to 1.6 v peak-to-peak.

Adjustment

1. Adjust the motion detector rack located on the carriage parallel to the carriage way within 0.002".
2. The pickup transducer mounted on the top lid of the actuator is adjusted to have a voltage output of 0.9 volts to 1.6 volts peak-to-peak and an air gap to the rack of not less than 0.004".

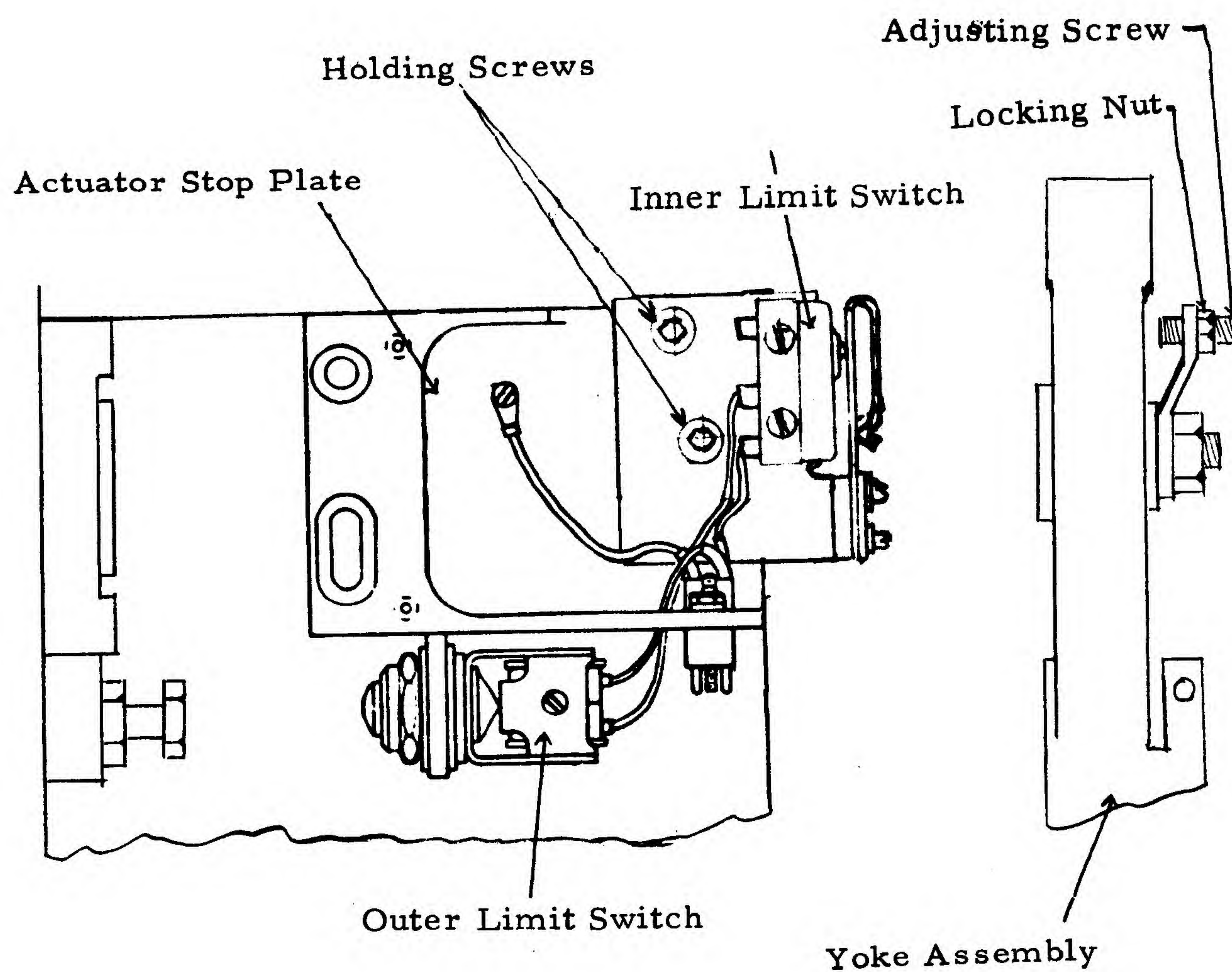


Figure 3-42 Limit Switch Adjustment

2163963	15349A
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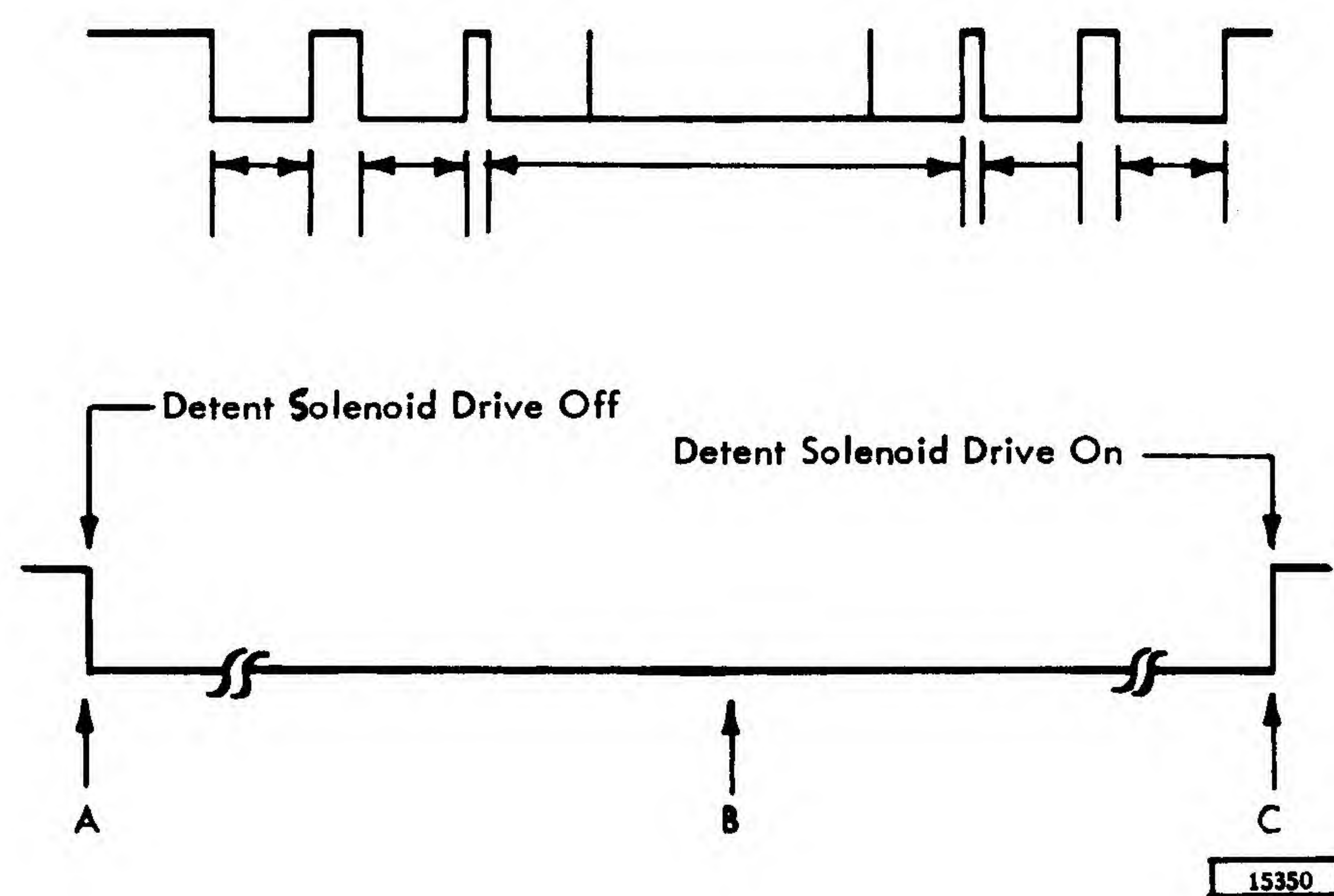
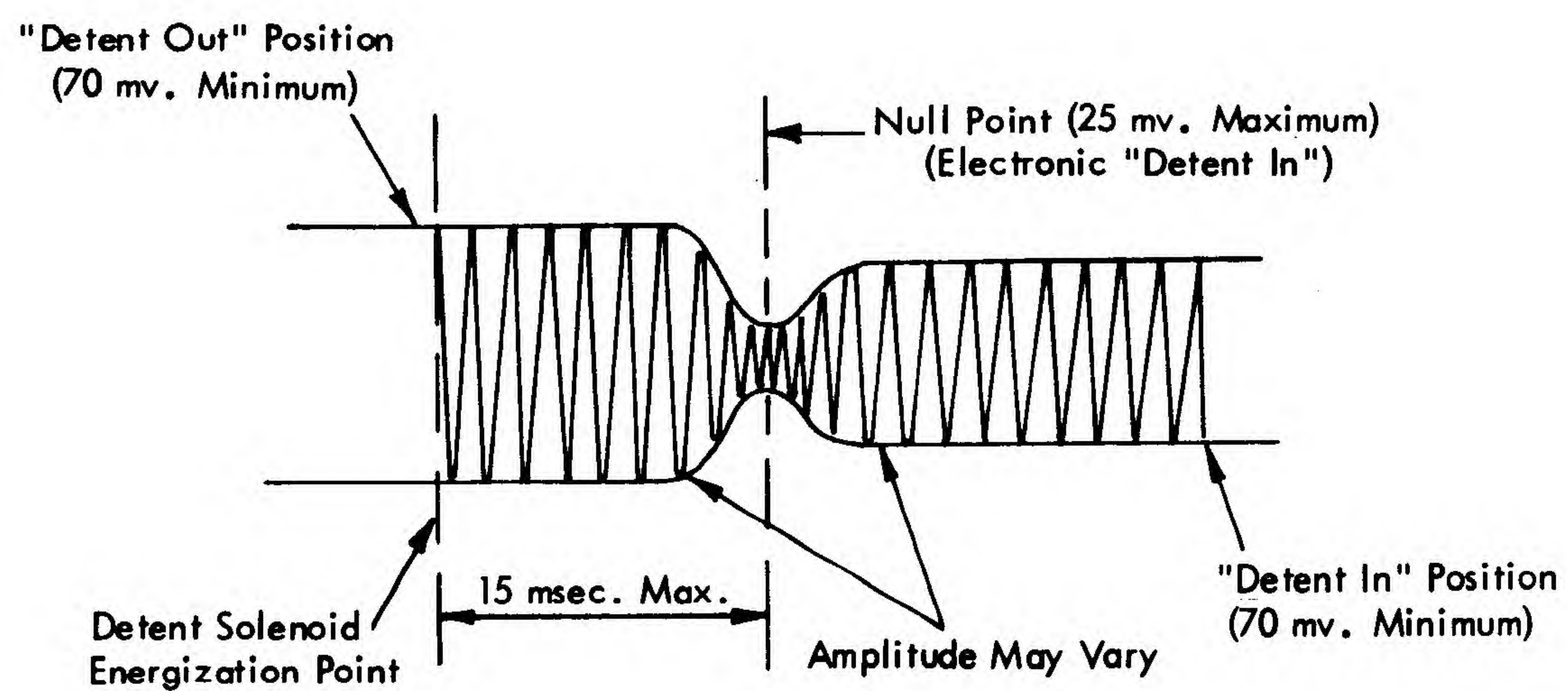
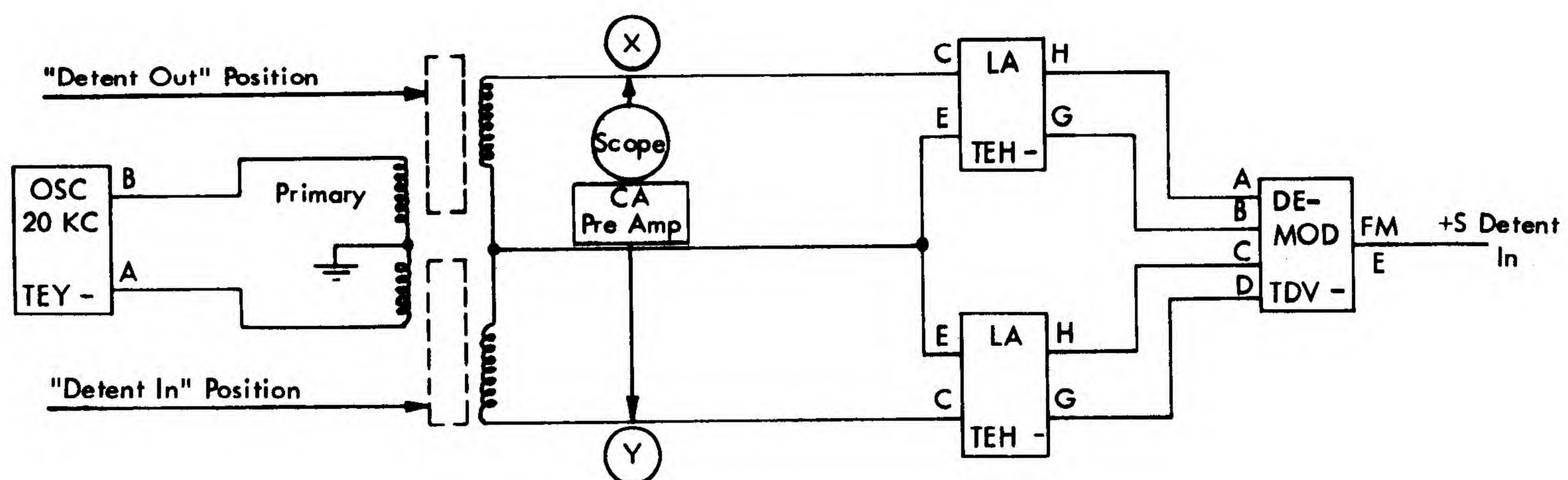


Figure 3-43 Motion Integrator

878558



878558 15351

Figure 3-44 Detent Detector

WARNING: The pickup transducer is magnetized, therefore, a nonmagnetic material (an IBM card for example) must be used to measure this gap.

3. Check this adjustment at both ends of the rack, to verify rack and actuator alignment (Figure 3-43).

3.4.4 DETENT DETECTOR

Service Check

The detent detector in the actuator cannot be adjusted or replaced, but it can be checked for normal operation.

The minimum differential signal as measured at X and Y of the secondary winding (Figure 3-44) is 90 millivolts. This minimum should be measured after a change in the logic signal of the detent-in line. The frequency of the differential signal is 20-30 kc. The differential signal amplitudes at detent in and detent out positions do not have to be equal.

The null point amplitude should not exceed 1/3 of the measured minimum or 35 mv peak-to-peak whichever is greater.

The time between the energization of the detent solenoid and the point at which the null is present should not exceed 15 ms.

If the detent is resting on a land, a low-level detent-out signal (approximately 30 mv to 65 mv) is present at X and Y. This low-level "detent out" voltage is lower than the normal 70 mv detent out voltage and higher than the null point.

3.4.5 ACCESS TIME

Service Check

Figure 3-44a gives the maximum access times for any single operation. These are the times required for the access to become ready after the cylinder portion of the Access Register has changed.

A rezero operation consists of three time intervals: (1) the 17 count detent hold; (2) the time required for the access to move at rezero force from any address to the outer limit stop; and, (3) the amount of time that the access stays at the outer limit stop position before attention status is brought up.

	PISTON INTERCHANGE						GLOB INTERCHANGE					
	Small Piston 1, 2, 4, 4'			Large Piston 10			Small Glob 20, 40			Large Glob 40', 40'', 100		
	No. of Counts	Min. Time	Max. Time	NO. of Counts	Min. Time	Max. Time	No. of Counts	Min. Time	Max. Time	No. of Counts	Min. Time	Max. Time
	11 1/2	49.00	49.91	27 1/2	117.18	119.35		66.05	67.27	27 1/2	117.18	119.35
Motion Time								16.50	15.00		16.50	15.00
Detent Drive												
Detent In and												
Reset SS												
Detent Delay							8 1/2	36.22	36.89	10 1/2	44.74	45.57
Time to Ready		49.00	49.91		117.18	119.18		118.77	119.16		178.42	179.92
Total Time	50 +0			120 +0			120 +0			180 2+0		
Allowable	-1			-3			-2			-2		

- Notes: 1. Single shot must be between 2.0 milliseconds and 6.0 milliseconds.
2. Minimum times are based on a motion oscillator adjusted to 4.261 milliseconds per count.
3. Maximum " " " " " " " 4.340 " " "
4. All times are in milliseconds (ms).

15788

Figure 3-44a Access Times

3.4.6 ACCESS COVER

Removal

1. Remove input power.
2. Vacuum the false floor and all surfaces surrounding the cover.
3. Remove access cover door.
4. After the disk array has stopped, loosen the screws on the front of the strut which retain the access cover and remove the cover.

Replacement

1. Clean cover and cover door with isopropyl alcohol and a lint-free soft cloth or tissue.
2. Vacuum the actuator, receiver, head loading mechanism, and internal surfaces of the strut to remove any accumulated particles. Be careful to use a light touch on the more delicate parts, such as arm stiffeners, in order to avoid damage.
3. Replace the cover so that it firmly seats with roller engaged in positioning bar and tighten the retaining screws.

3.4.7 ACTUATOR OUTPUT SHAFT SEAL

REMOVAL

WARNING: Cleanliness must be maintained during all steps so that actuators will not be contaminated.

1. Read out all data from file covered by actuator which is to be serviced.
2. Detent the output shaft at cylinder zero. Measure and record the space between the actuator outer limit stop and the carriage limit stop (see figure 3-4Q)
3. Turn off Power to the machine.



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Figure 3-45 Hydraulic Power Supply in Servicing Position

4. Remove the yoke, differential adjusting screw, and yoke adjusting block (see yoke removal).
5. Place several lint free tissues under the output shaft seal area to soak up the oil that will flow when the seal is removed.
6. Remove wiper seal cap including rubber support ring and felt wiper use tool P/N 2121394.

NOTE: Before proceeding be familiar with the replacement procedure and have parts available for immediate installation.

7. Remove seal assembly (use tool P/N 2121395 and 2121394).
Hold tissues under seal during removal.

REPLACEMENT

WARNING: To insure cleanliness and prevent contamination, the replacement parts must be left in their packages until they are needed.

1. Slide the seal assembly over the output shaft taking care not to damage the seal lip. Use back of tool pin 2121394 to push the seal into the actuator housing. Care must be taken to prevent damage to the O ring.
2. Install rubber support ring and wiper seal cap with felt wiper. Screw cap into actuator housing until cap is firmly sealed. (Use tool P/N 2121394).
3. Assemble yoke assembly (see yoke replacement procedure).
4. Start file.
5. Start Hydraulic power supply and allow the actuator to rest in the rezero position for 5 minutes.
6. Detent in track zero.
7. With the differential adjusting screw, adjust to dimension recorded in step 2 of removal.
8. Lock the differential adjusting screw into position by tightening the locking screw.
9. After normal warmup time with file ready "On", rewrite all tracks of serviced actuator.

3.5 HYDRAULIC POWER SUPPLY (FIGURE 3-45)

3.5.1 HYDRAULIC POWER SUPPLY AS AN ASSEMBLY

Removal and Replacement

1. Remove locking screw.

NOTE: Spring locking pin must be depressed by hand when positioning supply with respect to air duct at front of machine. Spring lock pin must also be depressed when removing the supply from the file.

2. Slide unit out rear of machine to servicing position (Figure 3-45).
3. Remove electrical connections.
4. Remove actuator air bleed lines and wrap ends in lint-free tissue.
5. Remove hydraulic connections after cleaning adjacent area.
6. Slide unit onto receiving platform of crate.
7. Put new unit in machine.
8. Attach electrical and hydraulic connections and actuator air bleed lines.
9. Check reservoir oil level.
10. Check that the direction of rotation of fan is counterclockwise when viewed over the top of the power supply.

3.5.2 OIL LEVEL

Service Check

Check the oil level. Add oil only when level does not appear in sight gage. Use only IBM P/N 2115252 which is one of pre-filtered oil in a disposable container. Dispose of container and any excess oil after filling supply.

3.5.3 SYSTEM PRESSURE RELIEF VALVE

Oil must be at normal operating temperature before any checks or adjustments are made.

Service Check

Close valve under manifold at large gage so that system pressure shows on gage. Place all actuators INOP. Check the system pressure (550 psi \pm 5 psi). Adjust if necessary. Open valve after checking or adjusting pressure so that gage is off. This protects gage from vibration and allows an orifice discharge for the system accumulator.

Adjustment

1. Unlock lock nut.
2. Adjust pressure by turning adjusting screw:
 - a. Clockwise rotation will increase pressure.
 - b. Counterclockwise rotation will decrease pressure.
3. Lock in place.

Removal and Replacement

1. Turn off hydraulic power supply.
2. Remove system pressure relief valve. Approximately 1 cup of oil will drain from this port.
3. Replace with new valve.
4. Adjust system pressure.

3.5.4 COOLING SYSTEM PRESSURE

Service Check

1. Set all actuators INOP.
2. Check cooling system pressure for 60 psi \pm 5 psi.
3. Pressure is read on pressure gage at the side of the manifold block.

Adjustment

1. Close thermal valve by screwing in plug.
2. Use low pressure relief valve.
3. Unlock locknut.

4. Adjust pressure to 60 psi \pm 5 psi by turning adjusting screw:
 - a. Clockwise rotation will increase pressure.
 - b. Counterclockwise rotation will decrease pressure.
5. Lock in place.

Removal and Replacement

1. Turn off hydraulic power supply.
2. Remove low pressure relief valve. Approximately 1 cup of oil will drain from this port. Verify that the "O" ring at the end of valve is removed with the old valve.
3. Replace with new valve. Verify that the "O" ring at end of valve is removed with the old valve.
4. Adjust new valve.

3.5.5 OIL TEMPERATURE

Service Check

1. Check the oil temperature indicated on the temperature gage. The oil temperature should be 123° F. \pm 2°F.
2. Before making any adjustment, check cleanliness of heat exchanger core. Remove lint collected on core and recheck temperature after 5 minutes.
3. Do not clean heat exchanger with hydraulic power supply on in order to avoid loose lint from being blown into the file area.

Adjustment

Place all actuators INOP for 5 minutes before adjusting.

1. Check the cooling system pressure as this has a slight effect on temperature.
2. Adjust the screw on the thermal valve. Clockwise rotation will increase temperature, counterclockwise rotation will decrease temperature. Generally a 1/4 turn equals 5°F.

NOTE: Allow 20 minutes after each adjustment for stabilization of temperature.

3.5.7 HYDRAULIC POWER SUPPLY FILTERS

Replace both paper filters every six months.

Replace the steel part of the mechanical filter every nine months.

3.5.7.1 Mechanical (System) Filter

Removal and Replacement

1. Shut down machine power using the normal sequence and remove all power plugs from wall.
2. Roll out hydraulic power supply to mechanical stop.
3. Carefully remove mechanical filter Cap by unscrewing from port in manifold. The paper filter and the steel filter should come out with the filter cap.
4. Remove paper filter from cap.
 - a. If a new paper filter is to be installed, scrap paper filter locally.
 - b. If only a new steel filter is to be installed, save used paper filter for reuse.
5. If a new steel filter is to be installed, assemble as follows:
 - a. Remove old steel filter from cap.
 - b. Remove the wrapping from the new steel filter, (P/N 2161309), using care to handle or hold at bottom end cap. Be sure that there is an O-ring on the outer diameter of the neck. Figure 3-45a shows field replacement O-ring.
 - c. Assemble the new steel filter to the cap by inserting it into the cap boss. Bottom the filter to the shoulder as shown in Figure 3-45a.
 - d. Drain oil from sump and fill with fresh oil.
6. Remove the wrapping from the new paper filter, (P/N 2161310), using care to handle or hold at bottom end cap. Be sure that there is an O-ring in the inner diameter of the filter neck. Figure 3-45a shows field replacement O-Ring.
7. Assemble the new paper filter or the used paper filter (See Step 5b) to the new cap by slipping the filter over the assembled steel filter and by fitting over the cap boss. Push the filter to the bottom of the boss as shown in Figure 3-45a.
8. Install the filter - cap assembly in the filter port of the hydraulic power supply manifold. When the upper cap O-Ring enters the manifold port, rotate cap slowly to prevent shearing or cutting the O-Ring. Continue rotating the cap

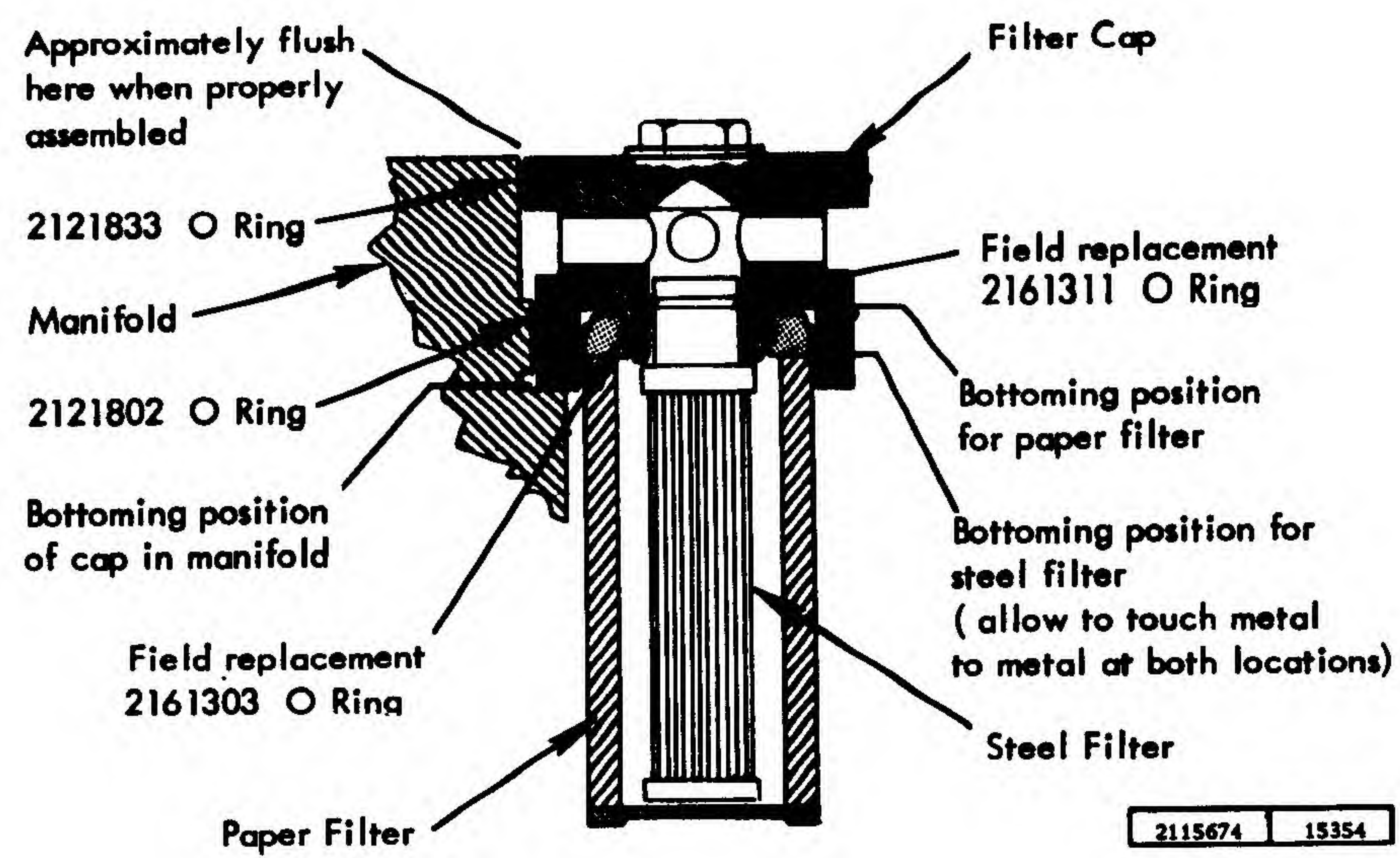


Figure 3-45a Mechanical Filter Assembly

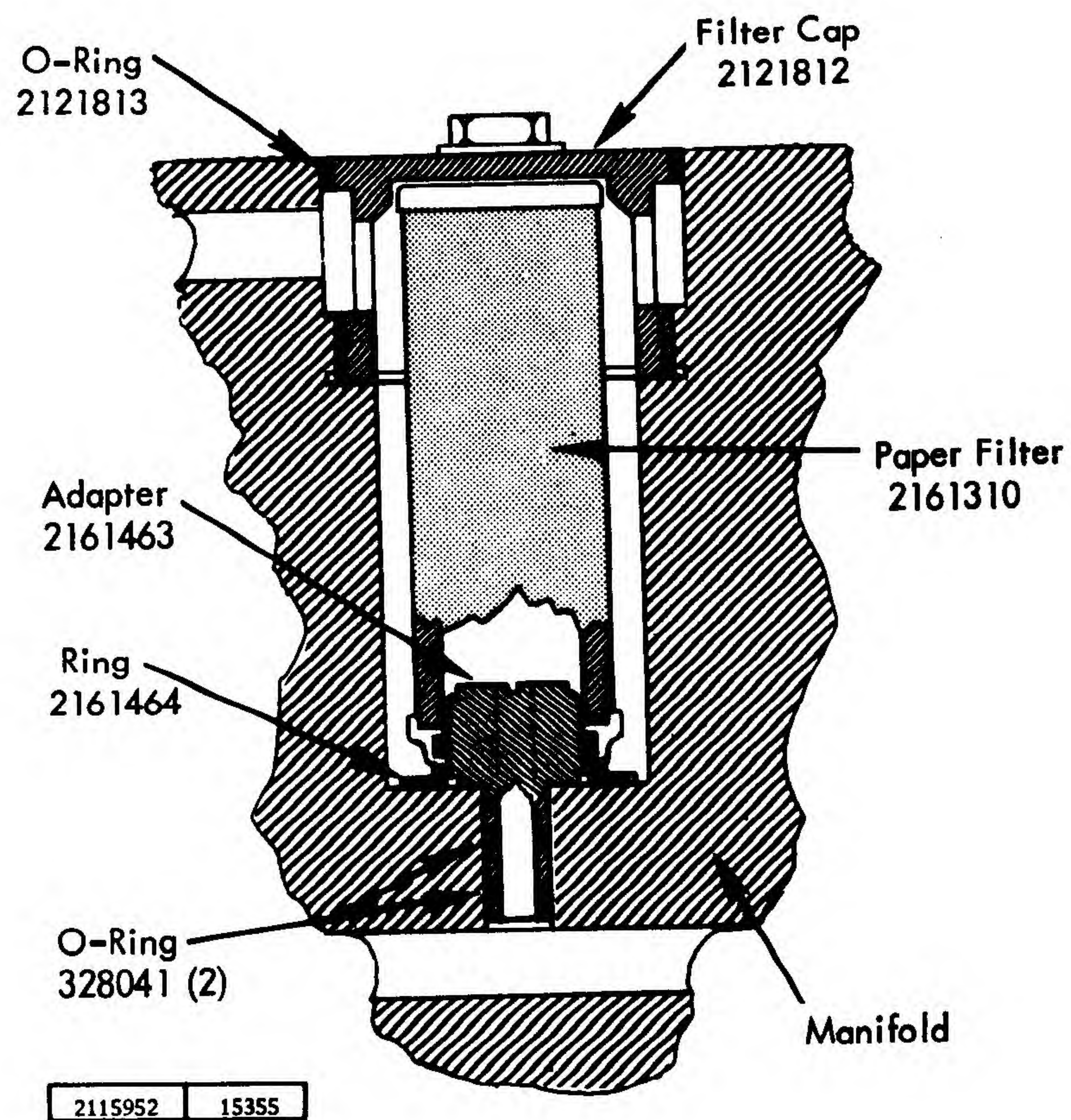


Figure 3-45b Paper Filter Assembly

until it just bottoms. Do not torque beyond this bottom position in which the top edge of the cap is approximately flush with the surface of the manifold. If the cap does not seat properly, remove and check the filters to be sure they are bottomed in the cap boss (Figure 3-45a).

9. If the paper filter was replaced proceed directly to Section 3.5.7.2 Step 1.
10. If only the steel filter was replaced proceed directly to Section 3.5.7.2 Step 6.

3.5.7.2 Paper Filter

Replace this filter at the same time the paper element of the system filter is replaced.

Removal and Replacement (Figure 3-45b)

1. Remove the Paper Filter Cap.
2. Remove the Paper Filter. Scrap filter locally. Do not attempt to remove the adapter or centering ring. However if they come out with the filter, replace them in this manner:
 - a. Place Centering Ring at bottom of exposed filter cavity in Manifold.
 - b. With the smallest diameter cylinder of the adapter facing downward, place adapter in filter bore and allow to fit into inner diameter of ring. Push the adapter into 1/2 diameter drilled hole at bottom of Filter Cavity. Rotate adapter using proper screwdriver on top slot so that the adapter will center itself in the ring. Do not burr edges of slot. Be sure that the adapter bottoms on the ring and bottom of the bore. See Figure 3-45b for proper fit.
3. Remove Paper Filter from package. Hold by end flange at closed end. Check for the presence of O-ring in open end. The O-ring replacement P/N is 2161303.
4. Insert the open end of the Paper Filter into the filter Cavity and over the adapter until bottomed on adapter. (The O-ring will fit and act as a seal on the adapter). The filter should be in a vertical centered position in the cavity.
5. Screw Cap into filter Cavity until it just bottoms. Do not tighten further. The top edge of the cap will be approximately flush with the top surface of the Manifold. If the cap does not seat properly, remove the cap and check for proper position of the filter. See Figure 3-45b.
6. Wipe excess oil from Manifold.
7. Replace the Power Plugs into wall and start the Hydraulic Power Supply.
8. Watch oil temperature and allow it to go up to normal operating temperature. The temperature should stabilize. Look for oil leakage around both Filter Caps. If leakage is evident, turn

off Power Supply and check condition of O-ring on the leaking Filter Cap. Re-assemble cap and turn on Power Supply.

9. Slide the Power Supply back into Machine and lock in place.
10. Close metal door
11. Machine is now ready for operation.

3.5.8 (Deleted)

3.5.9 (Deleted)

3.5.10 THERMAL SWITCHES

3.5.10.1 Over Temperature Protection

Adjustment

This microswitch is set to open at 130°F. Adjustments are not normally necessary.

3.5.10.2 Oil Temperature Thermal

Service Check

This switch is located on the sump line fitting of the hose sub manifold. This switch is set to close at 105°F. and is not adjustable.

3.6 (Deleted)

3.7 POWER SUPPLIES

Voltage Change

To change the voltage from 208v to 230v:

1. Move cable wire from bulk transformer terminal 4 to terminal 5.
2. Move cable wire from service transformer (T1) terminal 2 to terminal 3.
3. Move cable wire from TB300-4 to TB300-5.

3.7.1 48v SUPPLY (RELAY AND ACTUATOR)

The 48 volt supply must be between 42.6 volts and 50.4 volts. If these values cannot be met and input voltage and input taps are correct, change transformer output taps to obtain desired voltage. Refer to system diagrams for correct taps.

CAUTION: Turn off main-line switch (CBI) in contactor panel prior to changing transformer taps.

3.7.2 DC SUPPLIES

The DC power supplies (-48 not included) must regulate within $\pm 2\%$ of rated voltage, but are adjustable from $+4\%$ to -1% . Measure the voltages at the power supplies. If these values cannot be met and input voltage and input taps are correct, change transformer output taps to obtain desired voltage. Refer to system diagrams for correct taps.

The location of components within the power supplies are shown in the circuit diagrams. These diagrams should be used to find the part number and description of the suspected component. With the part number available, the physical location of the component can be easily located in the parts catalog.

All machine operations must function normally when the voltages on the electronic panels are:

1. Within $\pm 4\%$ of the rated voltage or
2. At the supply limits whichever occurs first
3. When the +12 marginal supply is varied from +9 to +12v.

New DC power supplies are available for replacement purposes. However over-voltage sensing and regulator cards are required with the new power supplies and must be ordered separately (Figure 3-45c).

3.8 ELECTRONIC COMPONENTS

3.8.1 READ CIRCUITS

WARNING: Do not put scope probes, leads or jumpers of any kind on the lines coming directly from the data or format heads. The heads can be damaged and/or data destroyed by possible potential differences.

1. The pulse width of the output (Pin E) of detector (EUK- at A5B10) must be 165 NANO seconds plus or minus 10% measured from the 10% up on leading edge to 10% down on trailing edge (System Diagrams page 01.05.06.1).
2. The peak-to-peak signal at the input to the pre-amplifier (SLT) for any data configuration should not be less than 1.0 millivolts. This applies to customer cylinders only.
3. The Amplitude ratio of single frequency bit recording (clock bits only) to double frequency bit recording (clock and data bits) should not exceed 3 to 1.

3.8.1.1 Format Read Amplifier Calibration

Three potentiometers are used in the format read amplifier and bit detector to facilitate setting the regulated signal output and the bit detection threshold.

Use a 1-to-1 probe or a X10 compensated probe with a wide band (2 megacycle or greater) preamplifier such as a CA or D. Sync on index (01A5E07B). Use an expanded scale of about 50 microseconds/cm and find an all bit pattern such as an AGC burst. Cylinders around 125 should be used as the amplitude difference between single bit and all bit patterns will be slight.

1. Set the machine in a continuous read condition on one head and one track. This can be done by setting the desired access INOP and turning on head select at CE Panel.
2. Balance the DC levels (no signal in) at pins H and G or test point 1 and test point 2 of the Overdriven and Limiter Amplifier (TEN-) at 01A5B14 within .1 volt by means of the potentiometer on card.
3. Adjust the voltage on pins A and F of the second linear amplifier (TEH-) at 01A5C13 to 6 to 6.25 volts peak-to-peak (measured differentially) by means of the potentiometer on 01A5C10. If this voltage cannot be obtained, the variable gain amplifier (TEV-), the AGC detector (TEQ-), the two subsequent linear amplifiers (TEH-) should be checked (Figure 3-46).
4. OBServe pin A or the OR -AND (ANW-) at 01A5B13 and, by means of the potentiometer on this card, adjust the clipping level to 50% (Figure 3-47).

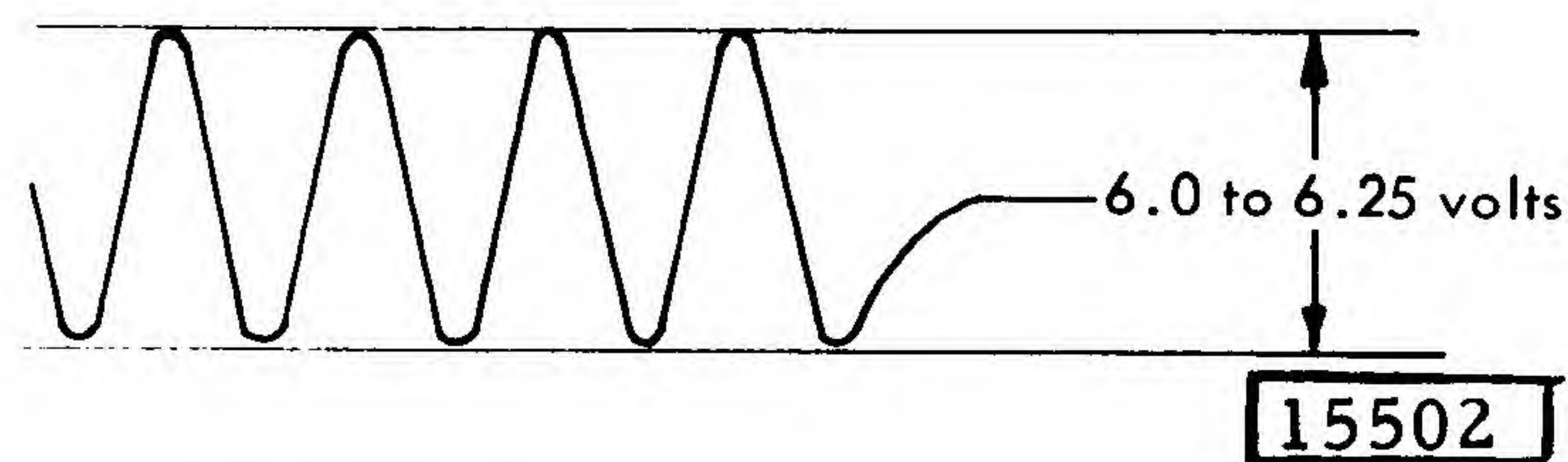
It is very important that the base line reference used for measuring the clipping level be after the recovery time as shown. Any overshoot is to be disregarded in the measurement of the 50% level.

NOTE: This ratio (2-1) is easily accomplished by maintaining E2 (Figure 3-47) at a constant vertical deflection of one cm (by means of the oscilloscope variable voltage control) and adjusting the potentiometer on the OR-AND (ANW-) to obtain a vertical oscilloscope deflection of two cm for E1.

DC Power Supplies		New Cards
New No.	Over Voltage Sensing	Regulator
473400	370575	370612
473390	370576	370610
472240	370577	370609
473450	370575	370612
473380	370576	370610
473550	370578	370608

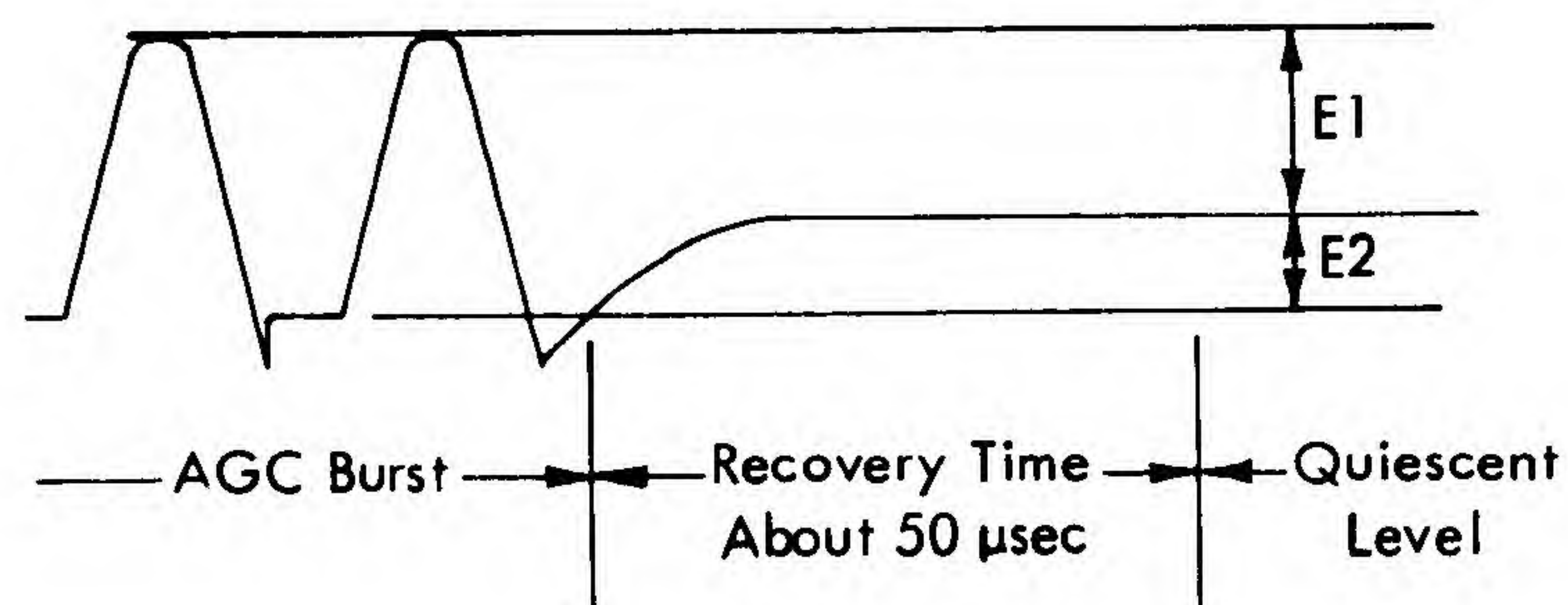
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Figure 3-45c DC Power Supply SMS Cards



15502

Figure 3-46 Voltage Output of Second Linear Amplifier



$$\frac{E2}{E1} = 50\%$$

15503

Figure 3-47 Format Read Amplifier Clipping Level

3.8.1.2 Read Amplifier Noise Rejection

If the read amplifier does not reasonably reject conducted line noise, the following conditions should be verified on each access:

1. The receiver assembly is electrically isolated from frame ground by at least 5,000,000 ohms and is to be connected to the J pin of the read Pre-amplifier card (TXD-).
2. The shields of the format head cable are connected to the J pin of the format Pre-amplifier card (TXT). The access ends of the shields are tied together and connected to the format drawer shield.
3. REMOVE all cables to receiver and check for an AC to DC short. Resistance between isolated receiver and frame ground should be greater than 2 meg-ohms.

3.9 STANDARD MODULAR SYSTEM MAINTENANCE

All normal maintenance procedures for standard modular system (SMS) components are found in the CUSTOMER Engineering Instruction-Maintenance Manual, Standard Modular System (Form 223-6900). Included in this form is information regarding:

Wrapped Wire Connections

Crimped Connections

Soldered Connections

Wiring Change Procedures

SMS Service Tools

SMS Card Maintenance

Measurements

Ventilating Systems

SMS Components

SMS Service Techniques

3.10 COMPRESSED AIR SYSTEM

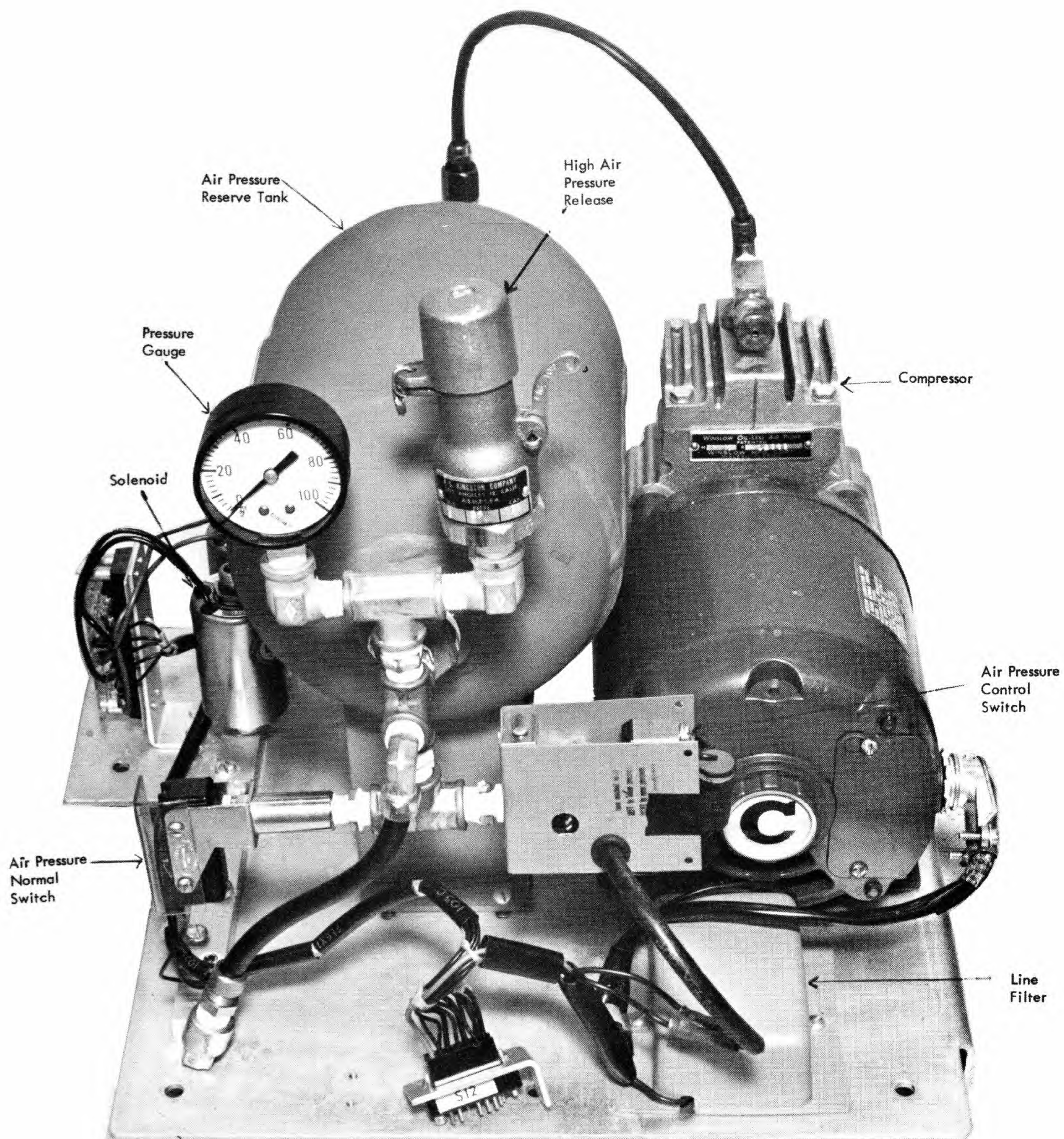
Service Check (Figure 3-48)

Pressure on air pressure gage should be 64-66 psi. Air pressure should remain constant without the air compressor running. Loss of pressure is indicated by frequent starting and stopping of the air compressor. The compressor should start no more often than once every two hours when the heads are loaded.

Adjustment

Air Pressure Normal Switch. Set this switch to close and turn on the Air-Pressure-Normal light on the Power Sequence Panel when the air pressure reaches 50 to 52 psi (Figure 3-49).

Air Pressure Control Switch. Set this switch to maintain 64 to 66 psi as indicated on the air pressure gage. The adjusting wheel (Figure 3-50) can be turned with the tip of a screwdriver.



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Figure 3-48 Compressed Air Supply

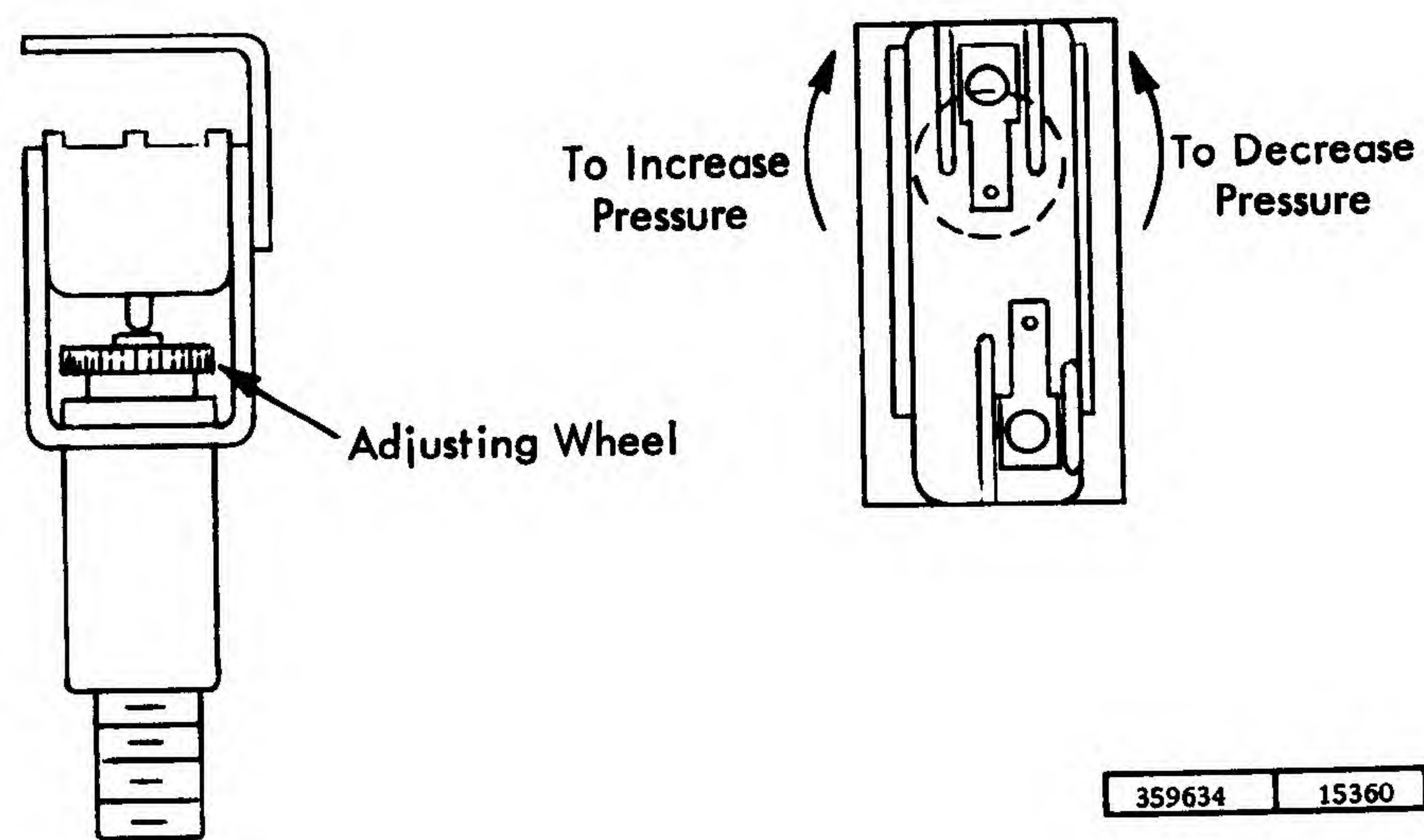


Figure 3-49 Air Pressure Normal Switch

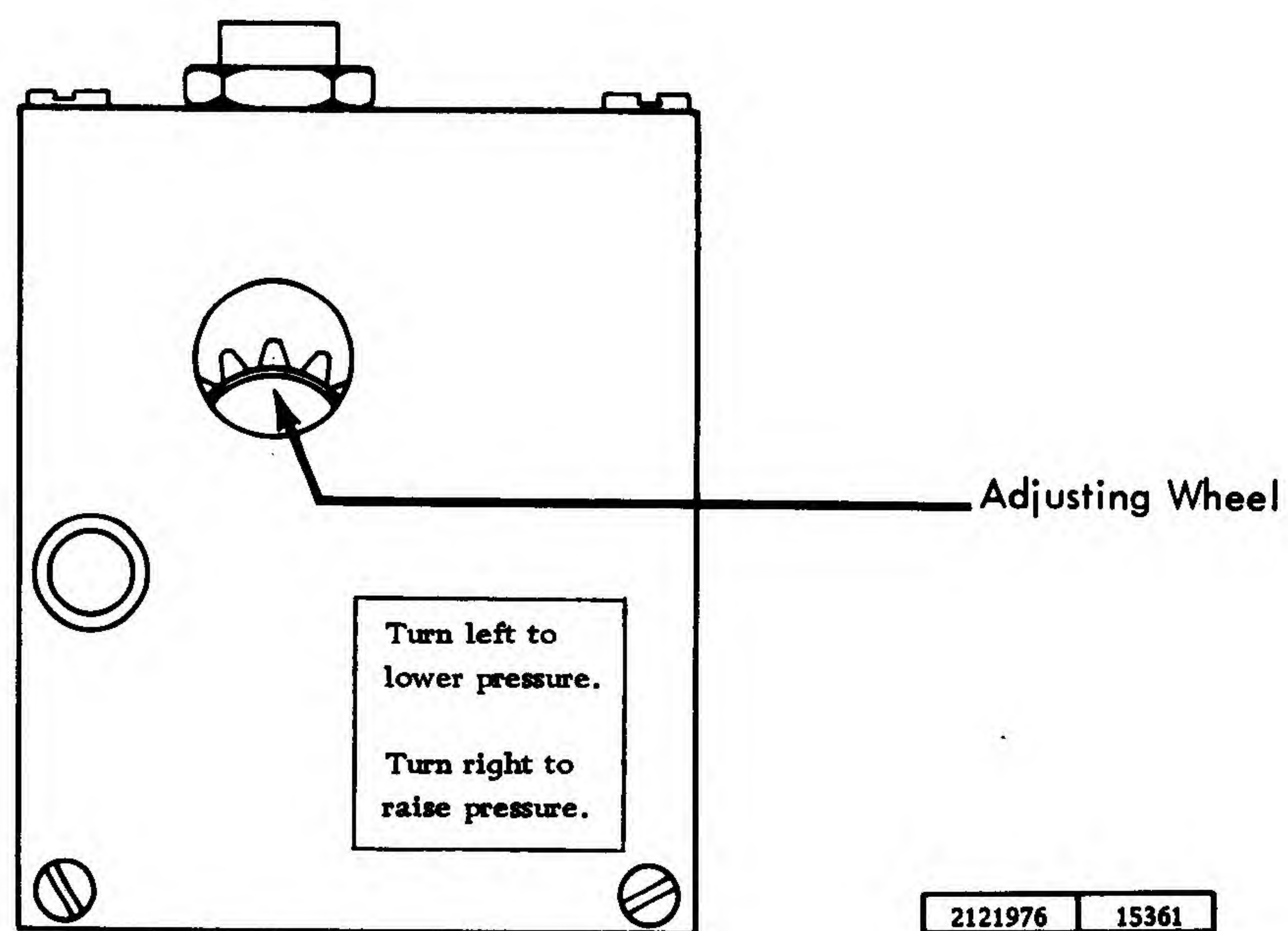


Figure 3-50 Air Pressure Control Switch

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CONTENTS

4.1 CE Test Control Panel	4.1	4.5 Power Sequence Controls	4.4
4.2 CE Remote Control Box	4.3	4.5.1 Power Sequence Panel	4.4
4.3 (Deleted)		4.6 (Deleted)	
4.4 Marginal Voltage Check Jack	4.3	4.7 CE Latch and Light (Systems Diagrams 01.06.02.1)	4.9
		4.8 Operator Controls	4.9

Many service aids are incorporated into the IBM 1302 Disk Storage. These aids allow the CE to observe or duplicate machine functions.

4.1 CE TEST CONTROL PANEL (Figure 4-1)

The CE test control panels are located in panels AL and B1. From these panels, the CE can monitor most file functions. However, the respective access must first be set inop and the access cover must be on before most of the switches on this panel are effective.

Head Select

The on-off toggle switch in the upper right corner turns head select on or off. This switch must be turned off to make other CE switches active. Both accesses on the same side of the 1302 must be "IN-OP" in order to turn on head select.

Cylinder Select Lights

Ten cylinder select lights indicate the contents of the access register and are driven by the outputs of the access register. Above each light is the binary and cylinder equivalent number represented by the light.

Head-Select Lights

Six head-select lights indicate the head to be selected. These indicators are driven from the access register. Above each light is the binary and decimal equivalent number represented by the light.

Flag Lights

These three lights indicate the status of the Flag latches (F1, F2, and F3).

Cylinder and Head-Select Switches

These switches can be used to select any cylinder-head address including the inner CE cylinder which is located at cylinder position 250 (100, 40", 40', 40, 20, and 10).

Access Register Set-REset

The address selected by the cylinder and head select switches is set into the access register by depression of the set button. Additional access register latches can be set without a reset. However, none can be turned off without a total reset. The access register is reset by depression of the reset button. This button also resets rezero if access is at outer limit switch.

Resetting the access register puts the actuator at cylinder 0 and gates head 00.

Rezero Set Switch

Two functions are performed by this switch: rezero, and locate CE outer cylinder. This position is not detented, and as long as the actuator is in rezero, the actuator can be moved manually with a small amount of force. Rezero can be reset by depression of the access register reset switch.

Flag Condition Select Switches

These three switches allow the CE to set the three flag latches which allow selection of any of the six alternate (flag) surfaces.

Limit Switch Light

This light indicates that the CE inner limit switch or outer cylinder limit switch has been located.

Attention Status Light

This light indicates that the access has ended a seek operation. If the access is not inop, a signal is sent to the FCU that indicates an end of seek.

Module Select Switch

This switch selects the module to be monitored or operated from the CE panel. Selection of a module also selects the access for that module.

Condition Indicator Lights

Head select, access ready, detent in, rezero, and access inop are the conditions indicated by lights.

CE Sync Hubs

These hubs are serviced by convenience wires between the FCU and the 1302. The line to the FCU is driven from the 1302.

4.2 CE Remote Control Box

Write Bits - Write Gate Switches (On Remote CE Box)

Depression of the write gate button raises the write gate if the access is located at the CE inner cylinder. DEpression of the write bits button allows one megacycle oscillator data to be put on the write data line. This data will then write on the selected head within the inner CE cylinder.

Seek Repeat

The "seek repeat" switch causes the selected access to actuate between the address set on the remote cycling box and the address set on C.E. panel.

Block Rezero

"Block Rezero" switch holds the REzero latch reset for the C E. for troubleshooting purposes.

Single Shot Settings

The two single shots in the remote cycling box should be adjusted as follows:

- a. DHE - at $G1A\phi 1$ to 18 milliseconds $\pm 5\%$.
- b. DHE - at $G1A\phi 2$ to 2 microseconds $\pm 5\%$.

4.4 MARGINAL VOLTAGE CHECK JACK

Marginal voltage checks of the electronic circuitry are made by placing the portable marginal voltage supply (Figure 4-1a) plug into the jack receptacle. The +12 marginal voltage can then be raised to +15 volts or lowered to +9 volts.

4.5 POWER SEQUENCE CONTROLS

The power sequence control panel (Figure 4-2) provides the facilities for starting and stopping the file during normal operations and ensures proper operation of file components. The sequence control may be either automatic or manual. The manual control of power sequence has been provided for CE manual start or component check. The automatic control of power sequence is under control of a 4-minute timing device. Normally, initiation of start on the first 1302 is under system control. Subsequent files, in remote control, are started on receipt of a timed pulse during the sequencing of a preceding 1302.

Indicator lights are provided as servicing aids for the Customer Engineer. They indicate both normal and malfunction conditions as long as the mainline 70-amp breaker is closed.

4.5.1 Power Sequence Panel

All power sequence functions are controlled by and monitored at this panel. The red lights indicate unsatisfactory conditions. The white lights indicate satisfactory conditions. Normal sequence is indicated by the small arrow heads next to the lights.

Auto Control Switch

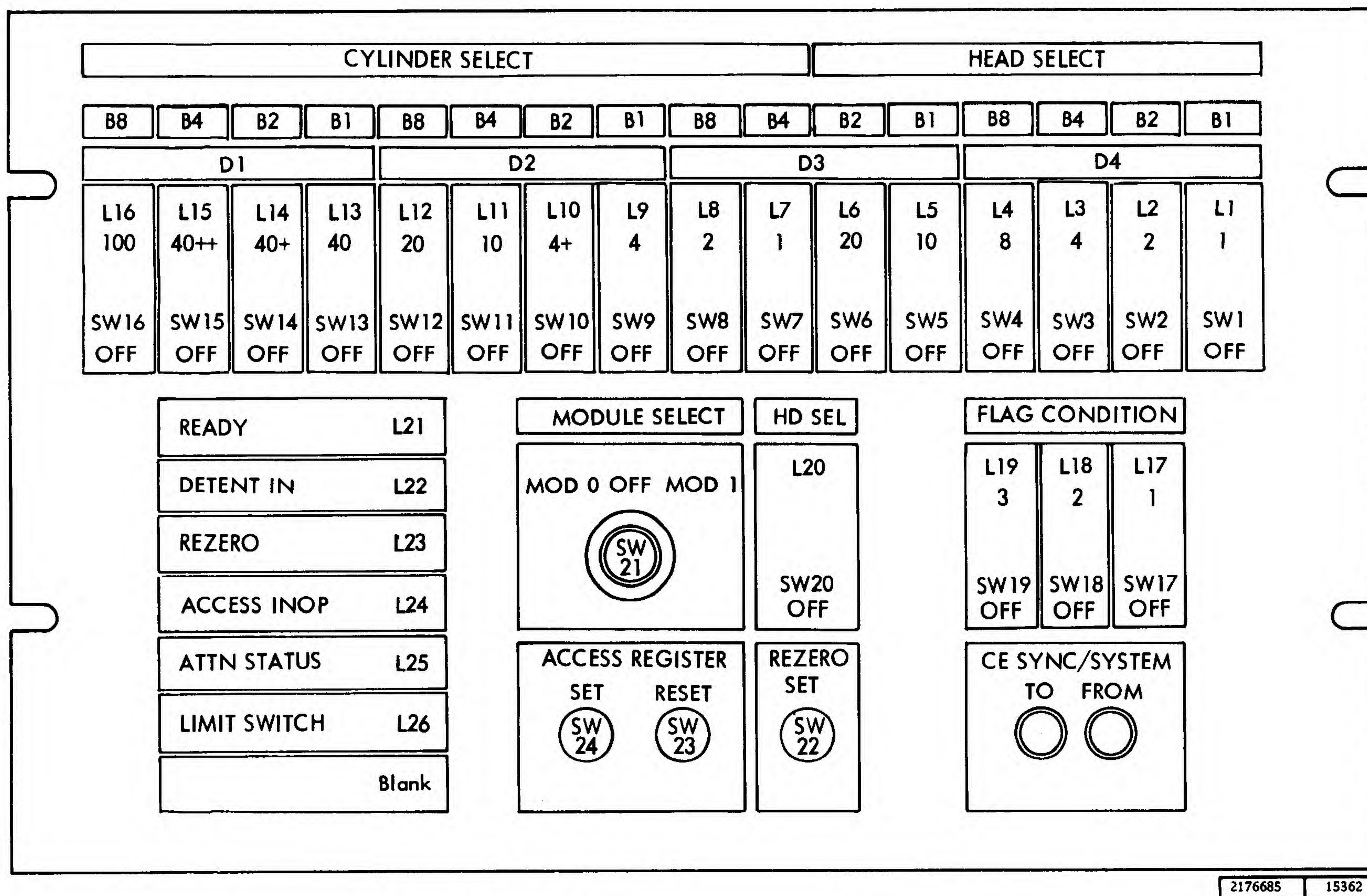


Figure 4-1 CE Test Control Panel

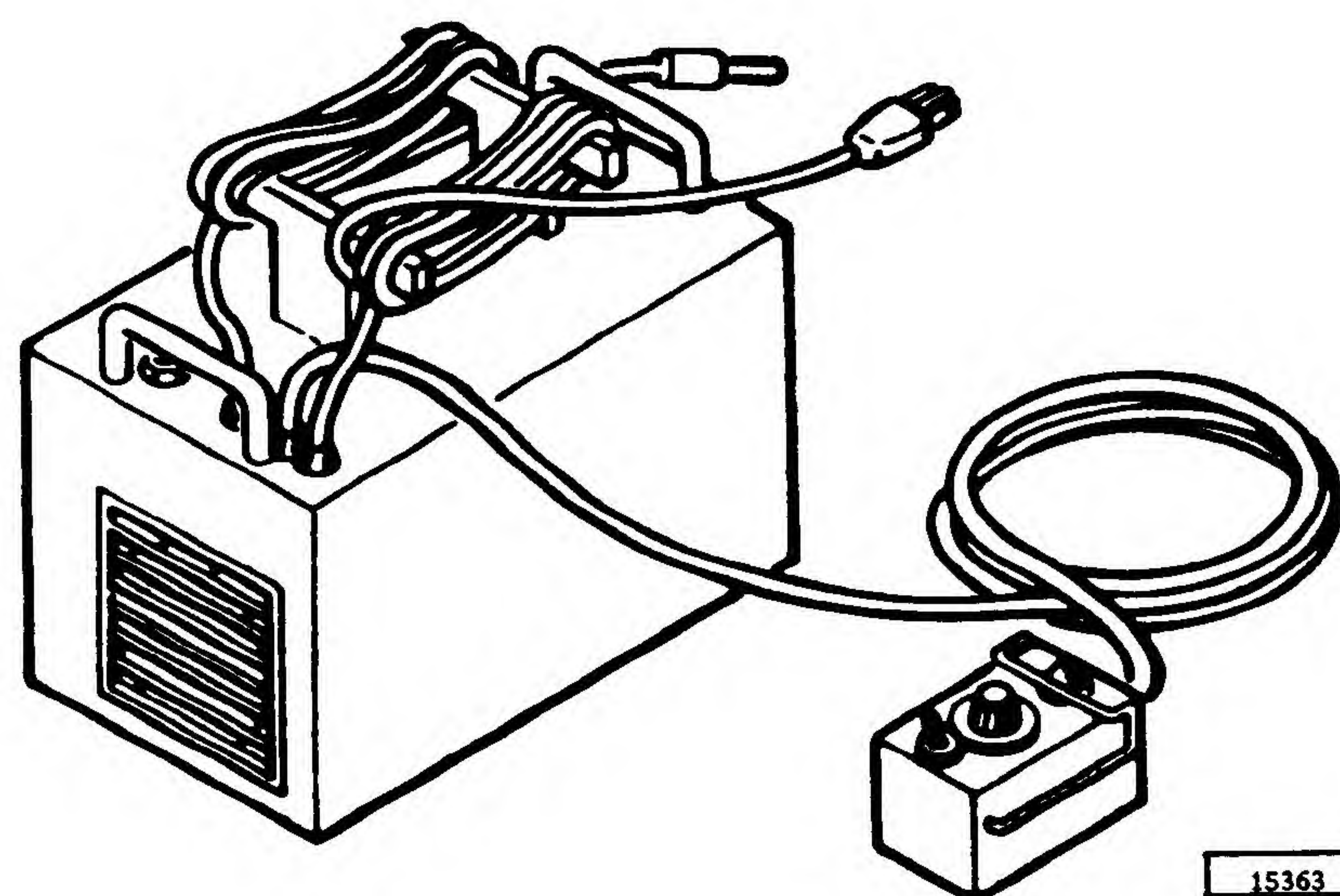
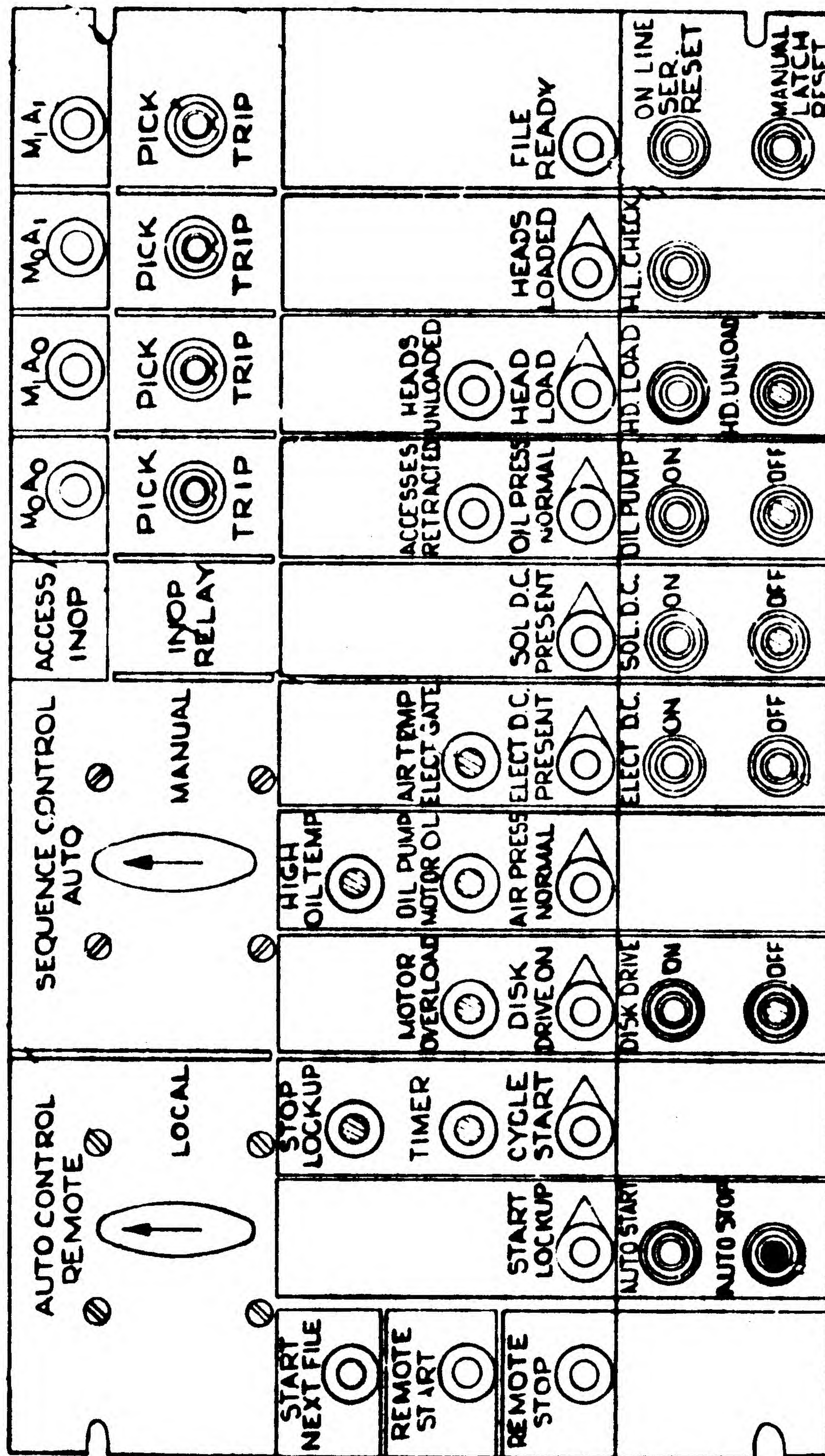


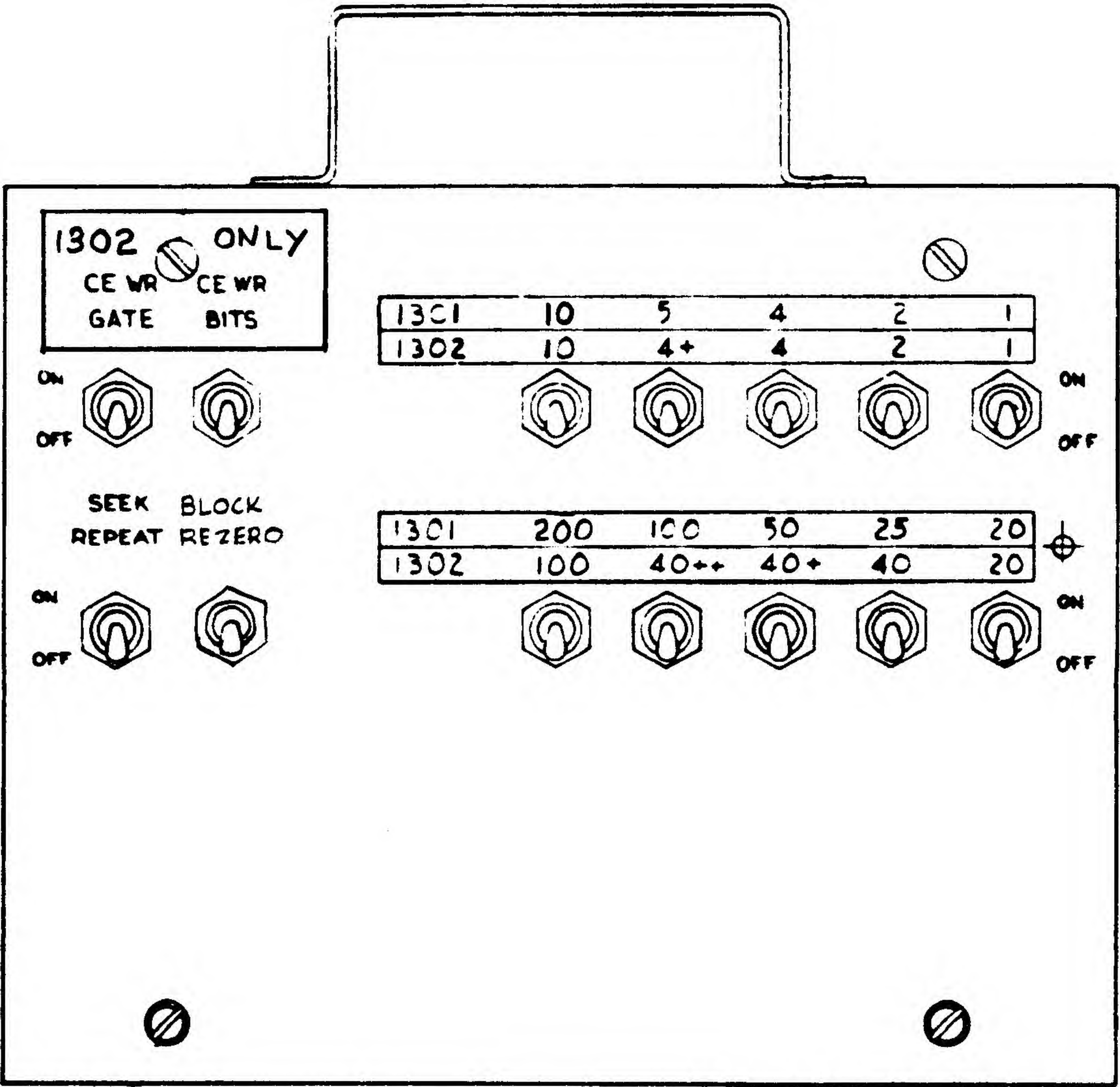
Figure 4-1a Marginal Check Unit



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Figure 4-2 Power Sequence Control Panel

Figure 4-3 (Deleted)



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Figure 4-4 CE Remote Control Box

This switch selects the originating point of the start or stop sequence signal. A remote signal originates at the system. A local signal originates with the start or stop switch on the 1302 power sequence panel.

Remote Local Switch

The remote local switch switches the control of power sequencing from the file control unit to the sequence gate. In local operation, power sequencing may be performed from the 1302 sequence gate in either the auto or manual mode. In remote operation, power sequencing may be performed from the file control unit. This switch must be in remote position for data transfer to file control unit.

Caution: If D.C. is off, it will come on when switched from local to remote.

Sequence Control Switch

Auto or manual sequence is selected by this switch. Auto sequence puts all functions under control of the sequence timer. Manual sequence allows the CE to select the time and sequence for most functions.

Damage to the heads or disks can result if the heads are loaded before the disks are at operating speed. To prevent this damage, the head load circuit is always directed through the timer 180-second contact. The disks and the timer, therefore, must run for 180 seconds before the heads can be loaded. In a stop sequence, the heads must be unloaded before the disk array is stopped.

Thermal Test Switch

If for any reason the File Power is turned off, and then back on within a short period of time, the thermal test switch will bypass the 30-min timer to bring up "File Ready," providing the thermal switch is also made.

System Function Lights

Remote start and remote stop from the FCU to the 1302, and start next file from the 1302 to the next file are indicated by these lights.

Access Inop Lights

If any access is put inop, manually or automatically, the associated inop relay picks, turning on the respective inop light.

Access Inop Switches

Manual operation of any of these switches causes an inop relay to be picked or tripped. Accesses that have been set inop by any method can be reset only by tripping the inop relays with these switches. If all accesses are set inop then relay 64 will drop causing the loss of "File R lady."

Auto Start Stop Controls

AUTO local start and auto local stop are initiated with the start or stop switches. The start lock up light comes on with the pick of R10 during an auto start sequence. The timer light is tied in parallel with the timer motor and is on whenever there is power to the timer motor. The cycle start light comes on with the pick of R111 at 15 seconds after the start of an auto power sequence start. During a manual sequence start, the cycle start light does not come on until the disk drive auxiliary (R32) picks. The stop lock up light comes on when R47 picks during any stop sequence.

Disk Drive

The disk drive on and off switches are for manual control of the disk drive motor. The disk drive can be manually started only if the heads are unloaded and the timer is at the beginning of a cycle. The disk drive light is in parallel with the disk drive contactor (K2). If a disk-drive-motor-overload switch or overtemperature switch opens, R39 picks and turns on the motor overload light. A disk drive overload or overtemperature condition causes a stop sequence to occur.

Electronic DC

The electronic DC On and off switches are for manual control of the electronic DC power. If electronic DC is applied R44 picks to turn on the electronic DC present light. An over-temperature condition in an electronic gate causes R48 to drop. R48 picks R36 which turns on the electronic air temperature light.

Solenoid DC

The solenoid DC On and off switches are for manual control of the solenoid DC power. The solenoid DC present light is turned on

when R8 is picked by K301. Solenoid DC can come on only when electronic DC is present. Loss of electronic DC results in dropping solenoid DC. This protects the solenoid driver cards from damage caused by having 48 volts without proper biasing voltages.

Oil Pump

The oil pump on and off switches are for manual control of the hydraulic power supply motor. An oil level switch in the hydraulic system picks R7 when the oil pump is turned on through relay 102. R7 turns on the oil pump light. Opening an overload in the oil pump drops R2 which in turn picks R40 which turns on the motor overload light. When the temperature of the oil exceeds 130°, R49 drops to pick R38 which turns on the high oil temperature light.

Head Load

The head load switch is for manual loading of the heads. The switch is effective only after the timer has run 180 seconds. This time must be allowed to build pressure in the array and remove particles of dirt. The head unload switch is for manual unloading of the heads. In any stop sequence, the heads must be unloaded before the disk array can be stopped.

Before the heads can be loaded, at least one access must be retracted and air pressure must be normal (above 50 psi).

The accesses retracted light is picked by R4. R4 is picked by all the access retracted switches or inop relay points in series. The air pressure normal switch closes to pick R46 which turns on the pressure normal light. The head load light is turned on by R125. R125 also picks the clock head solenoid and the head load air solenoid control (K202). The heads unloaded light is turned on by the pick of R43. R43 will pick only if all the heads, including the clock head, are unloaded. The head load check switch is for manual control of the head check operation. DEpression of this switch in manual control will pick the head load check relay (R45). This relay, in series with the head loaded switches on each access and the clock head, will pick R5 if all heads, including the clock head are loaded. R5 turns on the heads loaded light.

File Ready

The file ready light is turned on by the file ready relay (R64) if all of the following conditions are present.

1. Not stop sequence delay.
2. Heads loaded.
3. Electronic DC present.

4. Oil pump normal.
5. Solenoid DC present.
6. Solenoid power supply control.
7. Strut temperature normal. (See Section 1.3.)

Manual Reset

Depression of the manual reset switch is the only way the following conditions can be reset.

1. Disk drive overload.
2. Electronic air overtemperature.
3. Oil overtemperature.
4. Oil pump overload.
5. DC failure indication.
6. Air pressure normal (after disk drive on).

4.6 (Deleted)

4.7 CE Latch and Light (System Diagrams 01.06.02.1)

The CE aid is an electronic latch with an indicator attached. The latch has a 4-way (plus) ANDed input and 1 reset (minus) LINE. Any inputs not used may be left floating. The indicator is attached to the on side of the latch.

4.8 Operator Controls

Format Write Switch

This switch is located on the front right-hand vertical strut of the mechanical frame. It must be set to WRITE before the format track can be rewritten. The switch must be "off" in order to operate both accesses.

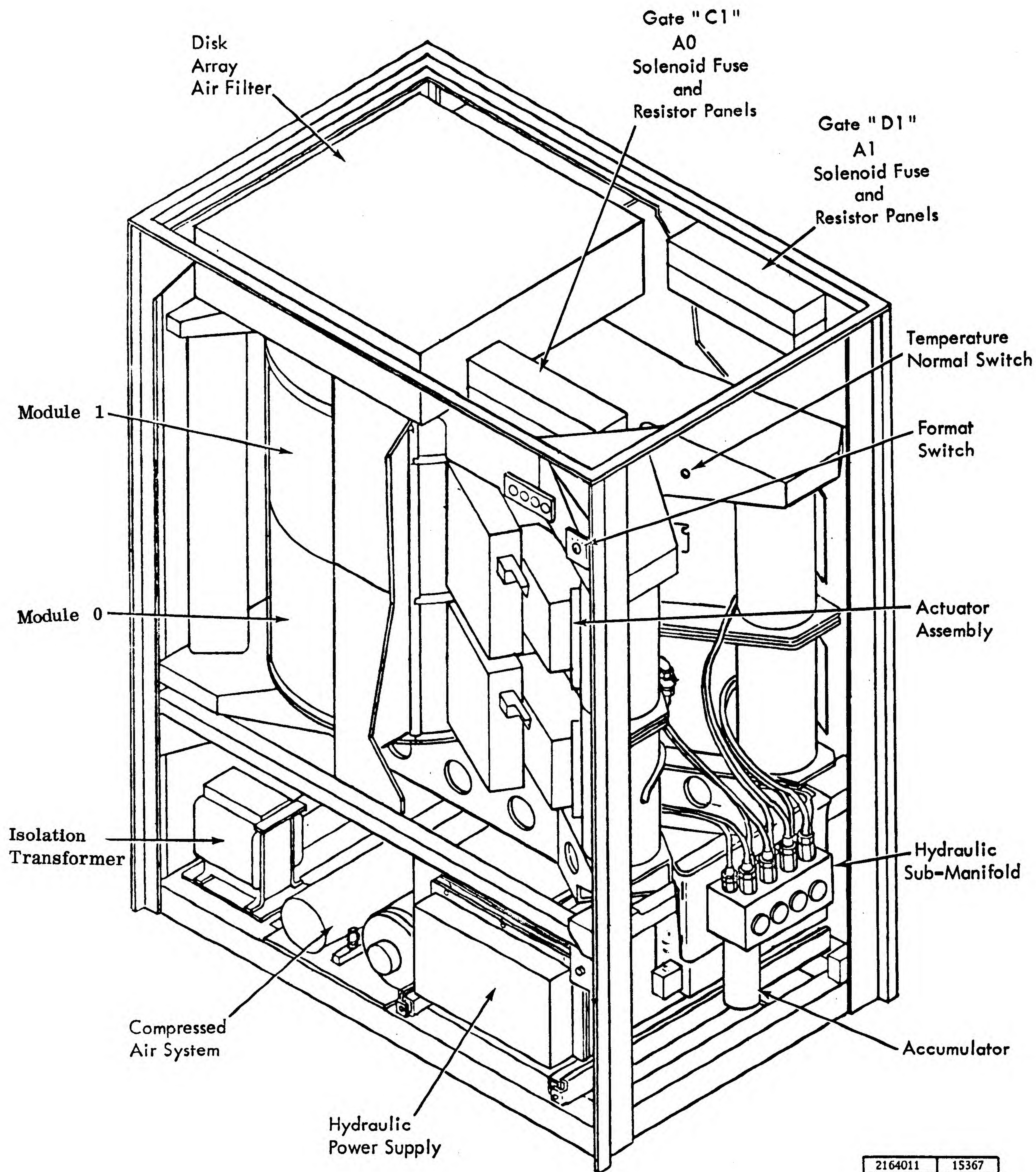
Ready Light

This light indicates that the file strut is up to operating temperature and file is ready for transfer of data.

SECTION 5 LOCATIONS

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Figure 5-1 Mechanical Frame

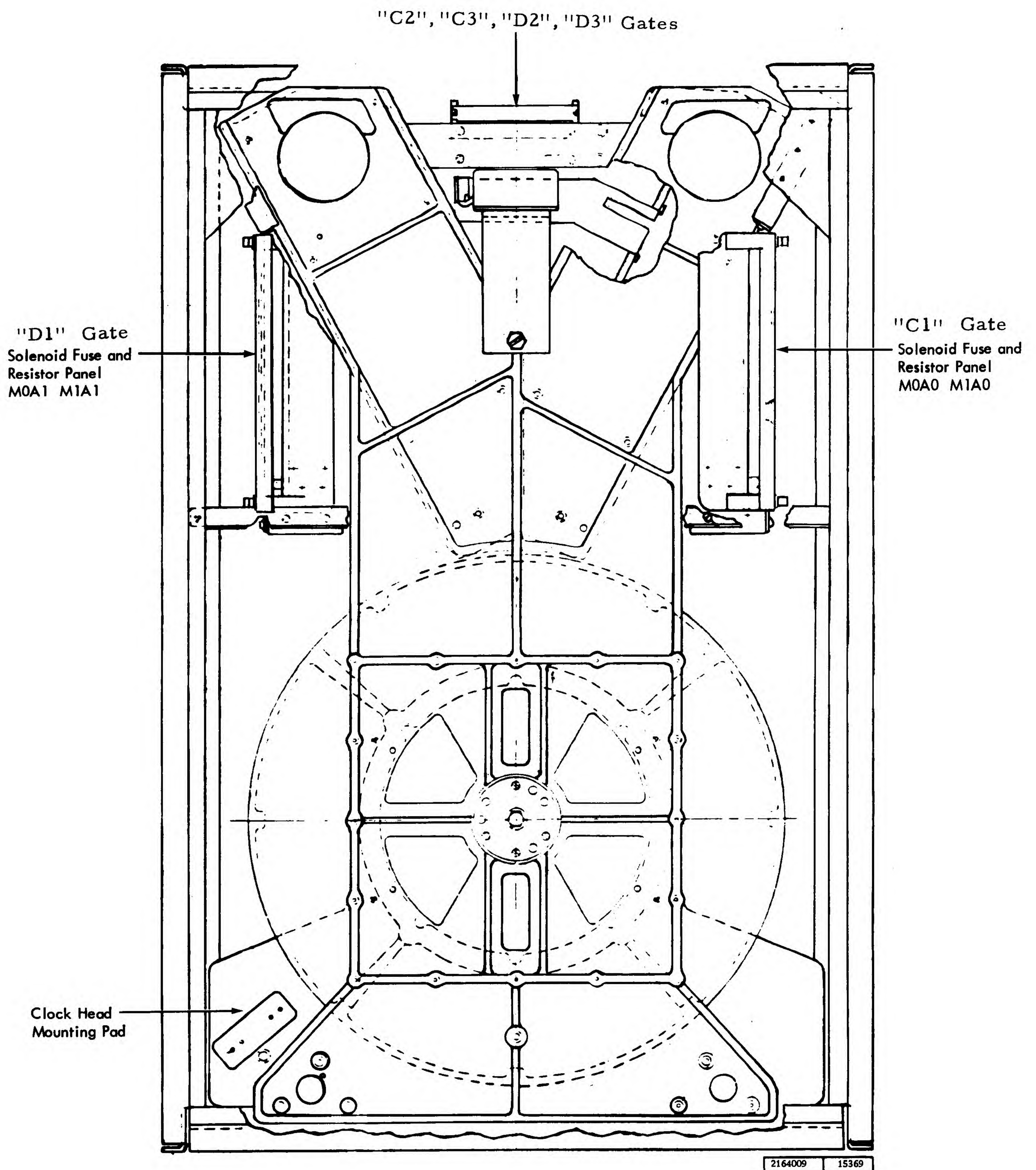


Figure 5-2 Mechanical Frame -- Top View

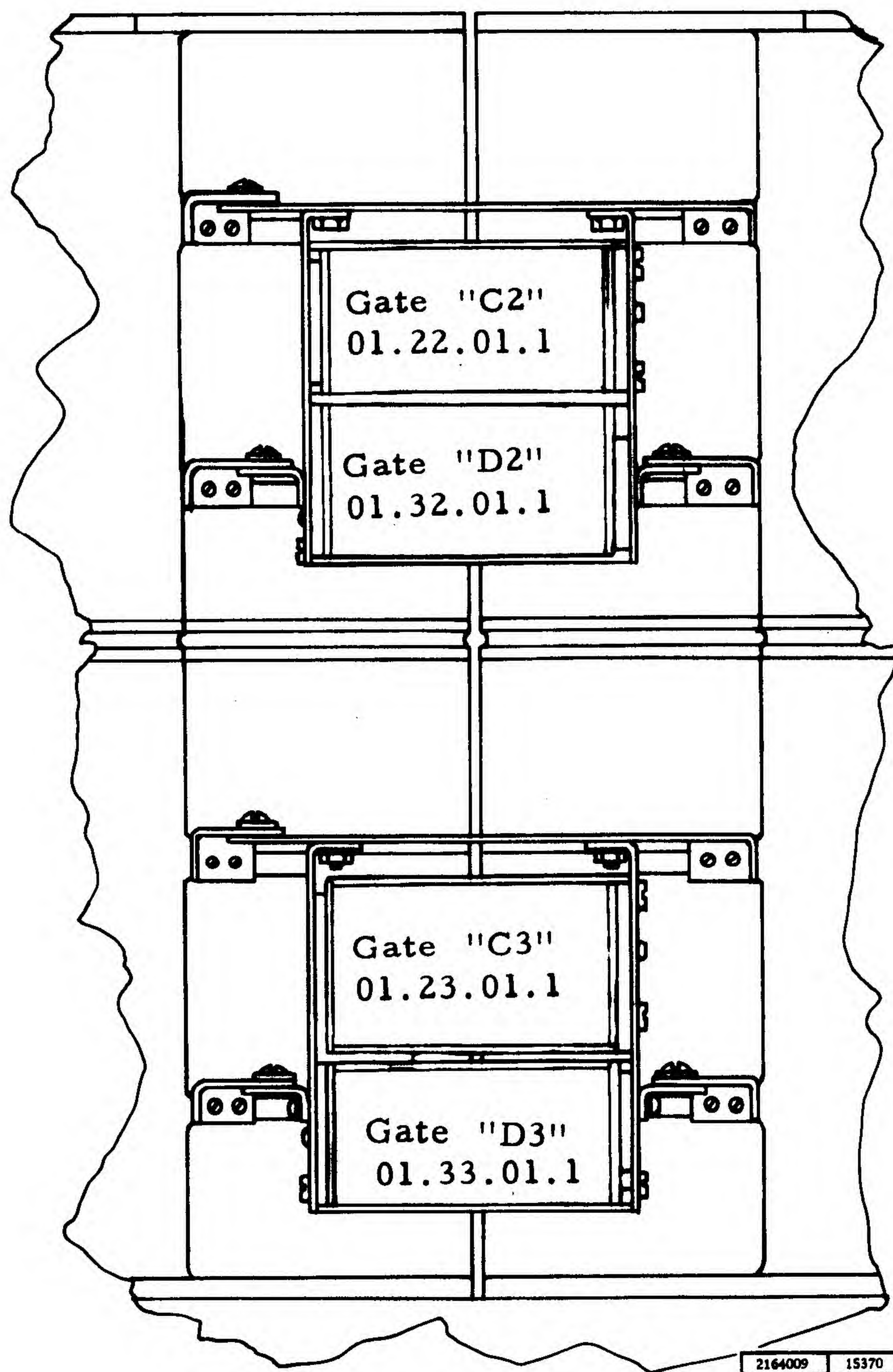


Figure 5-3 "C" and "D" Gates

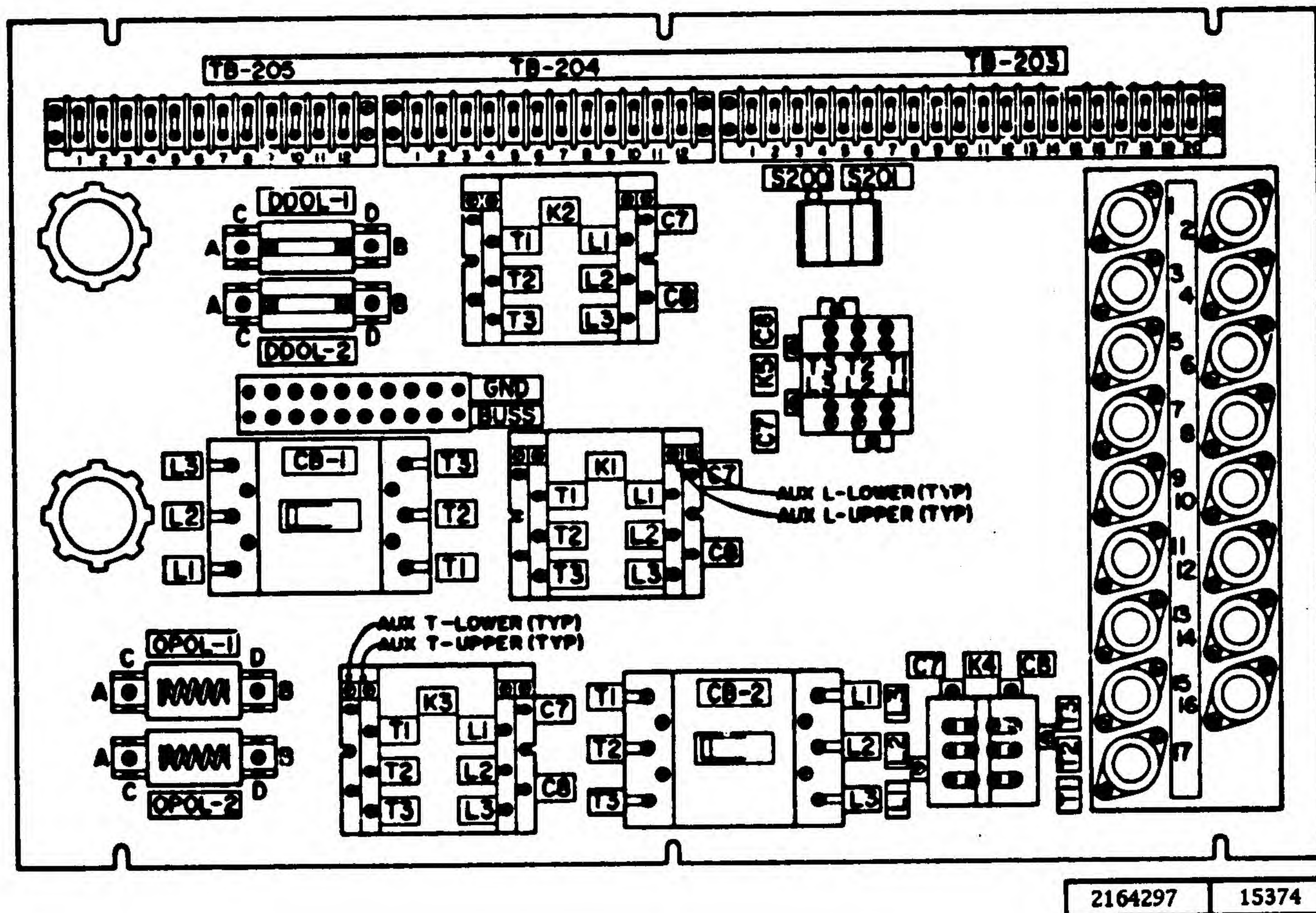


Figure 5-4 Power Contactor Box -- Uncovered

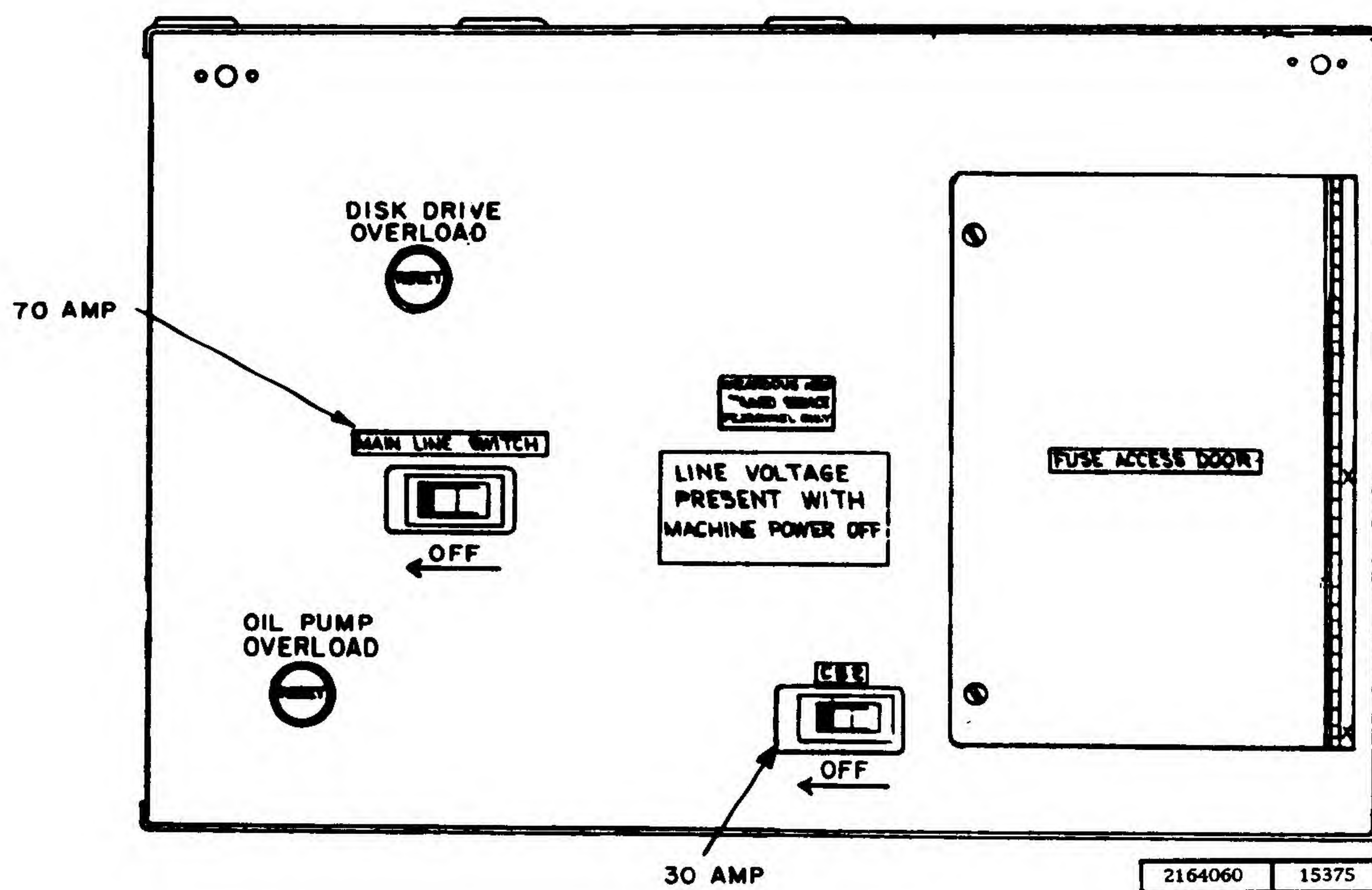
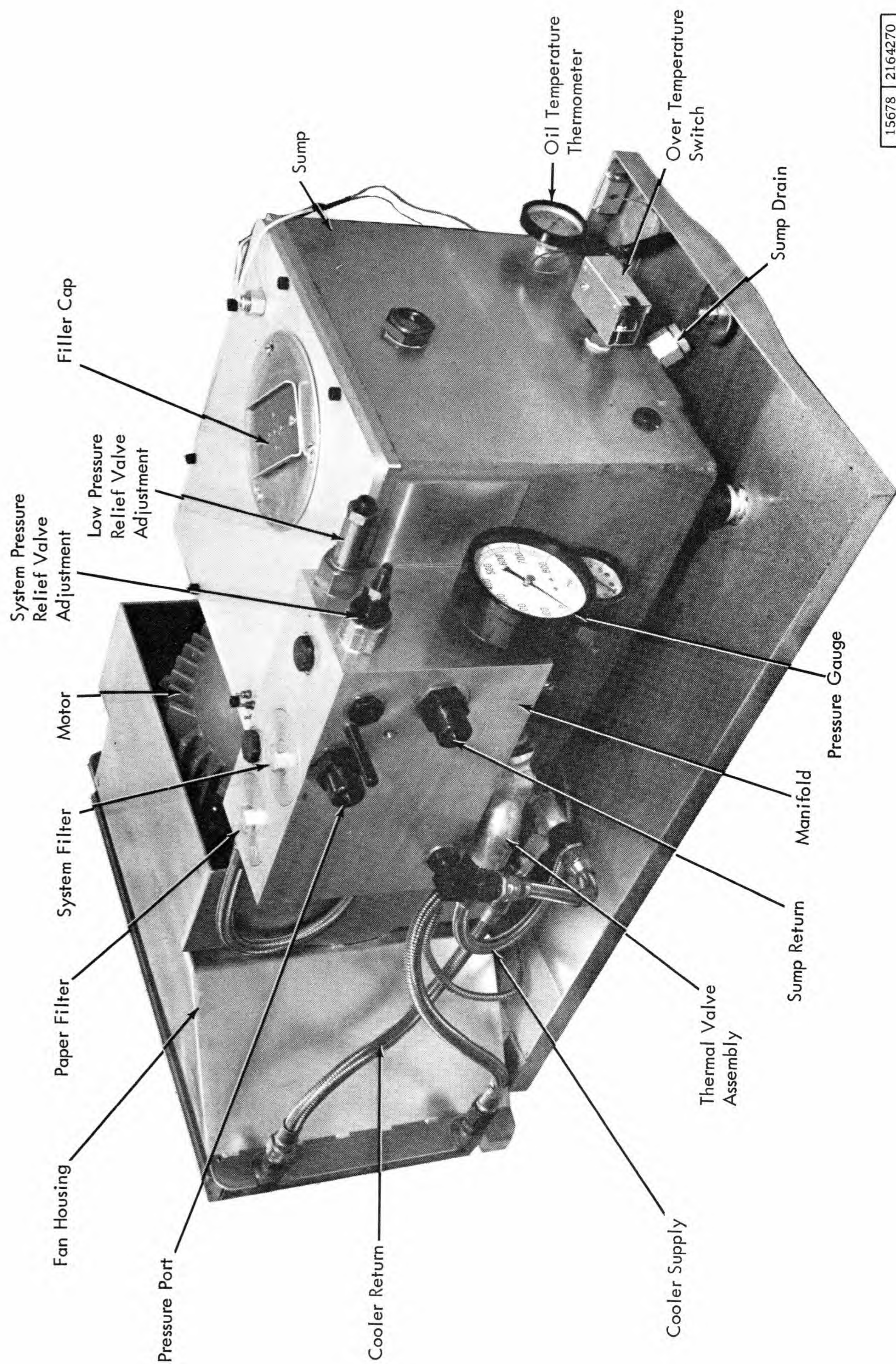


Figure 5-5 Power Contactor Box -- Covered



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Figure 5-6 Hydraulic Power Supply

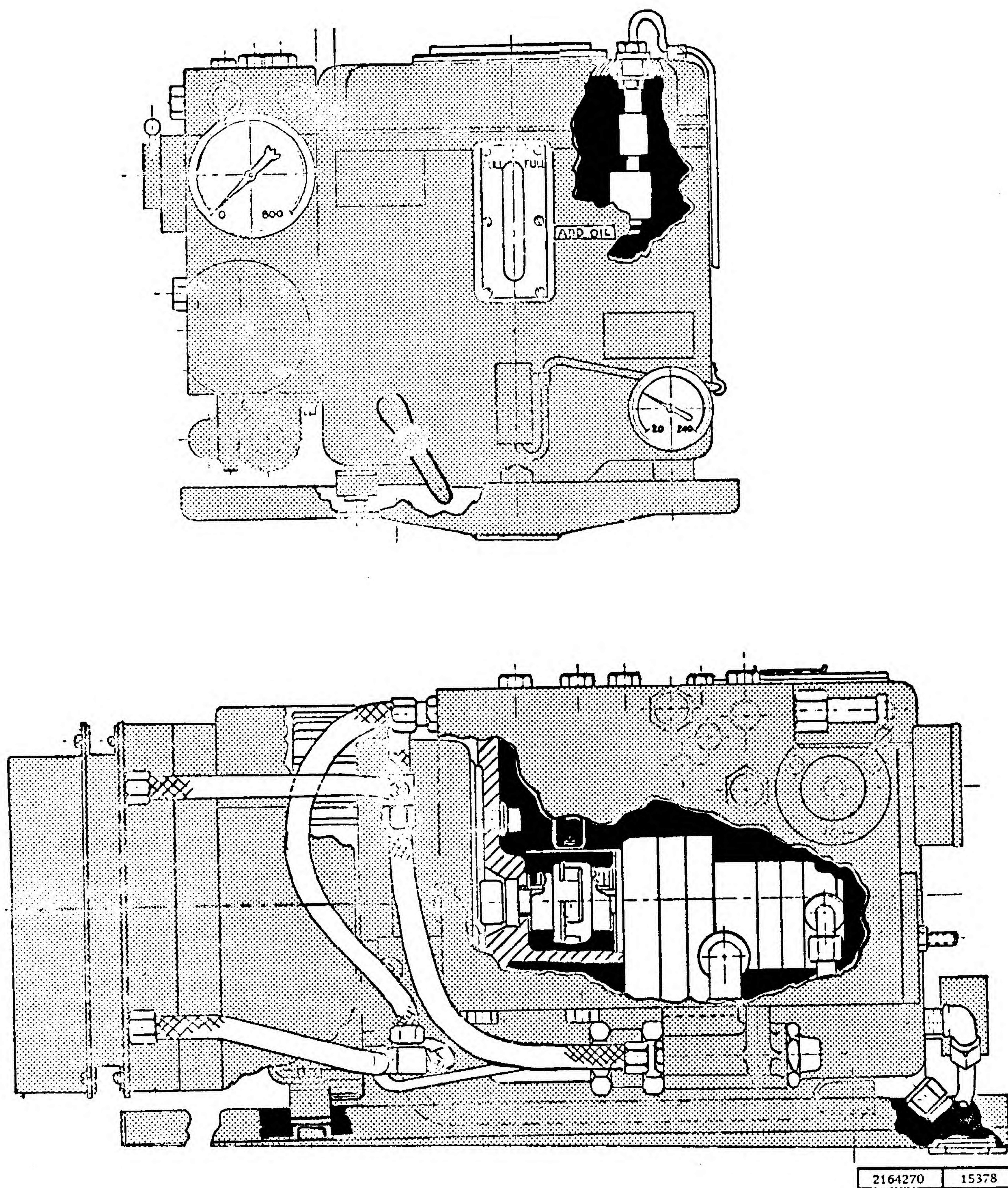


Figure 5-7 Hydraulic Power Supply

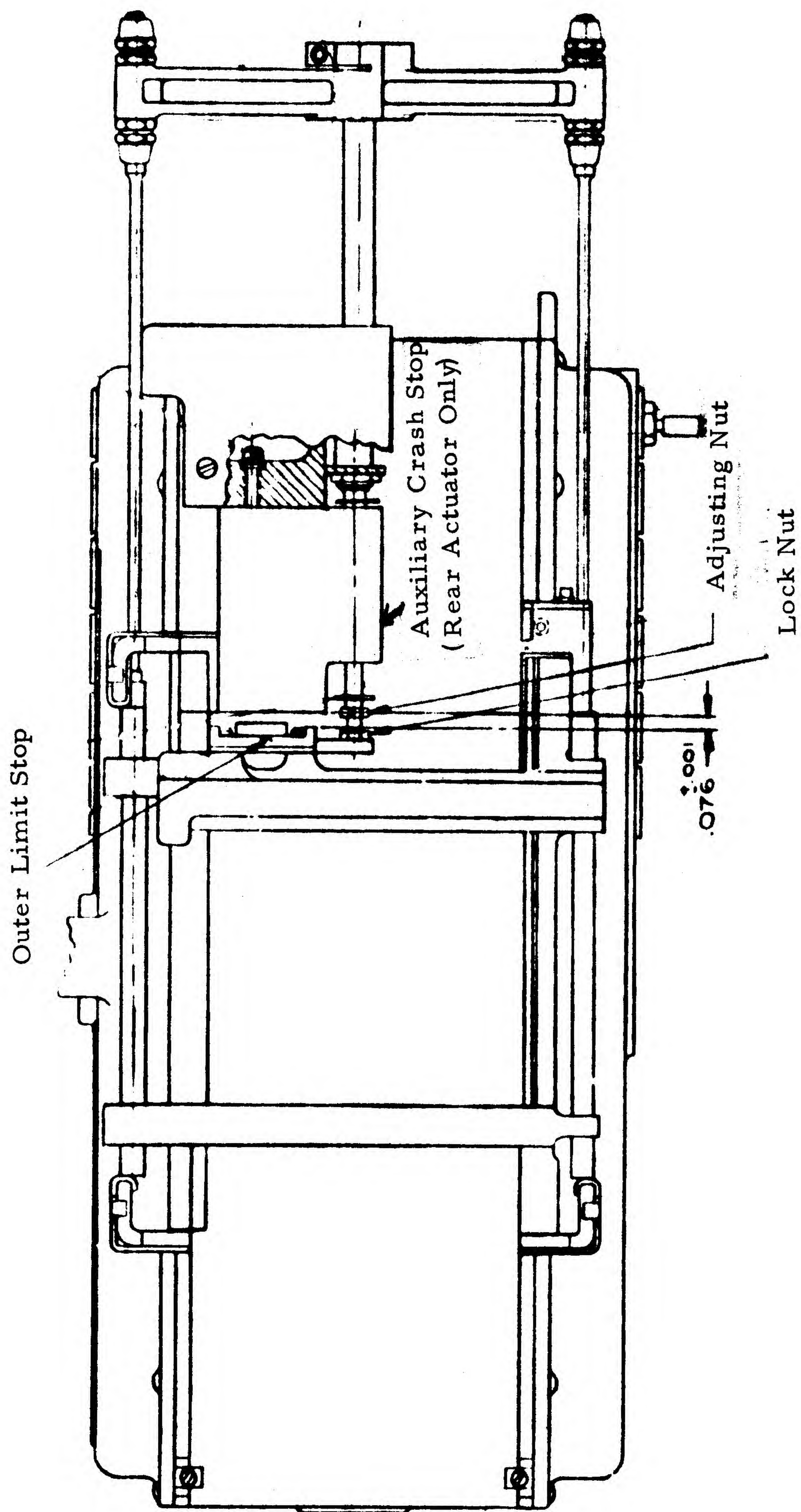


Figure 5-8 Actuator-- Rear

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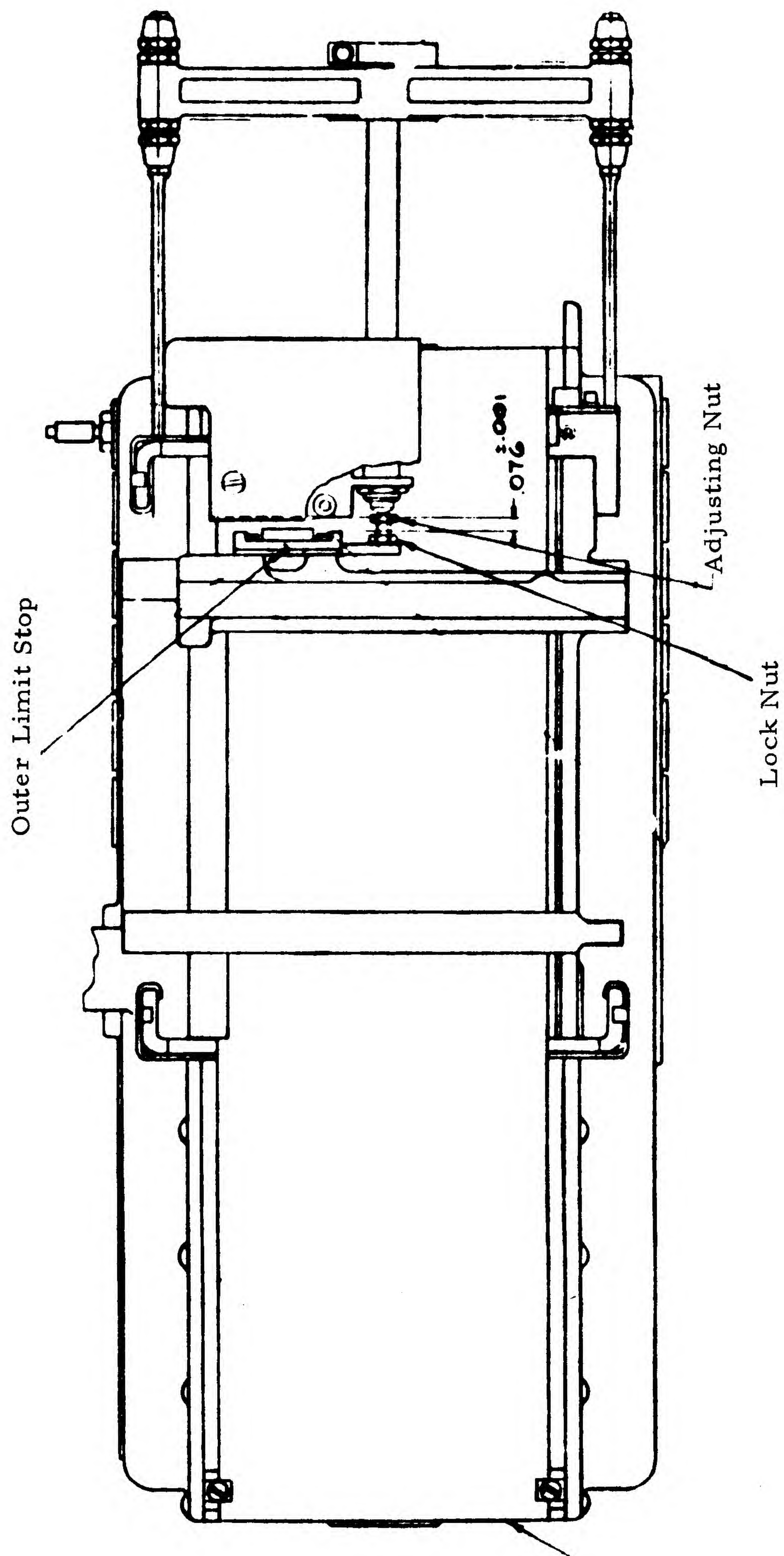


Figure 5-9 Actuator-- Front

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Figures 5-10 through 5-19 (Deleted)

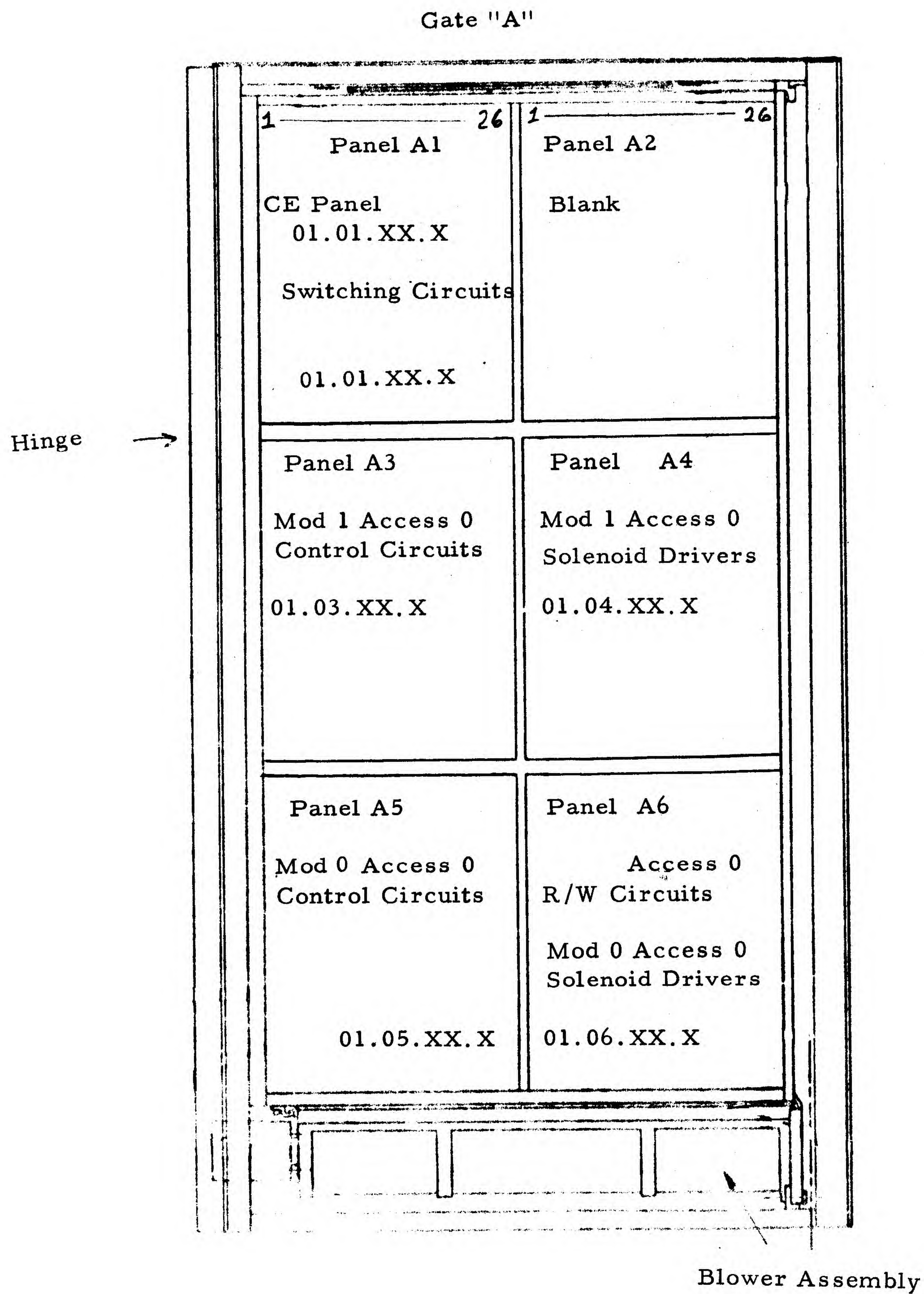


Figure 5-20 Electronic Frame -- Front

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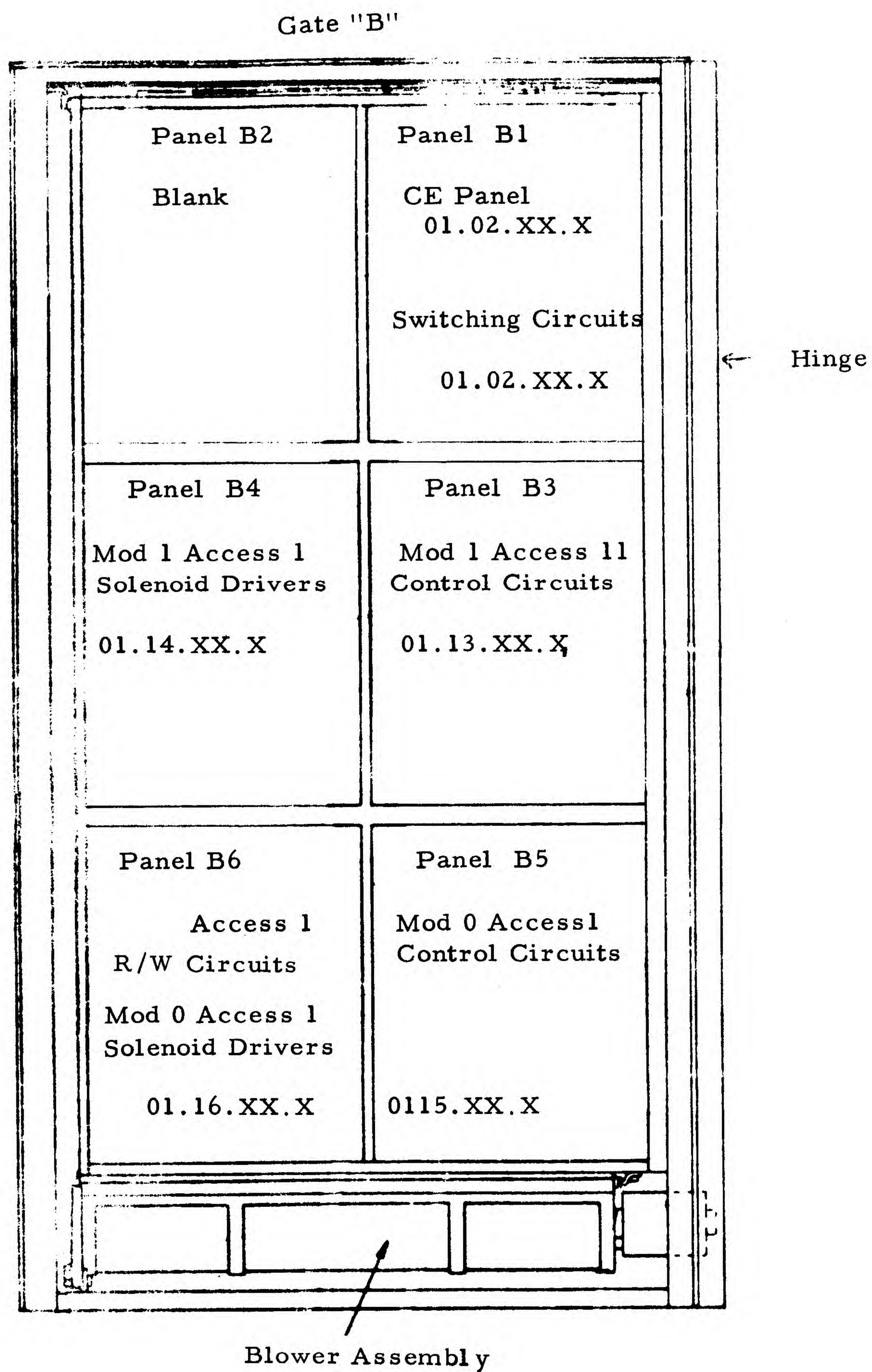


Figure 5-21 Electronic Frame -- Rear

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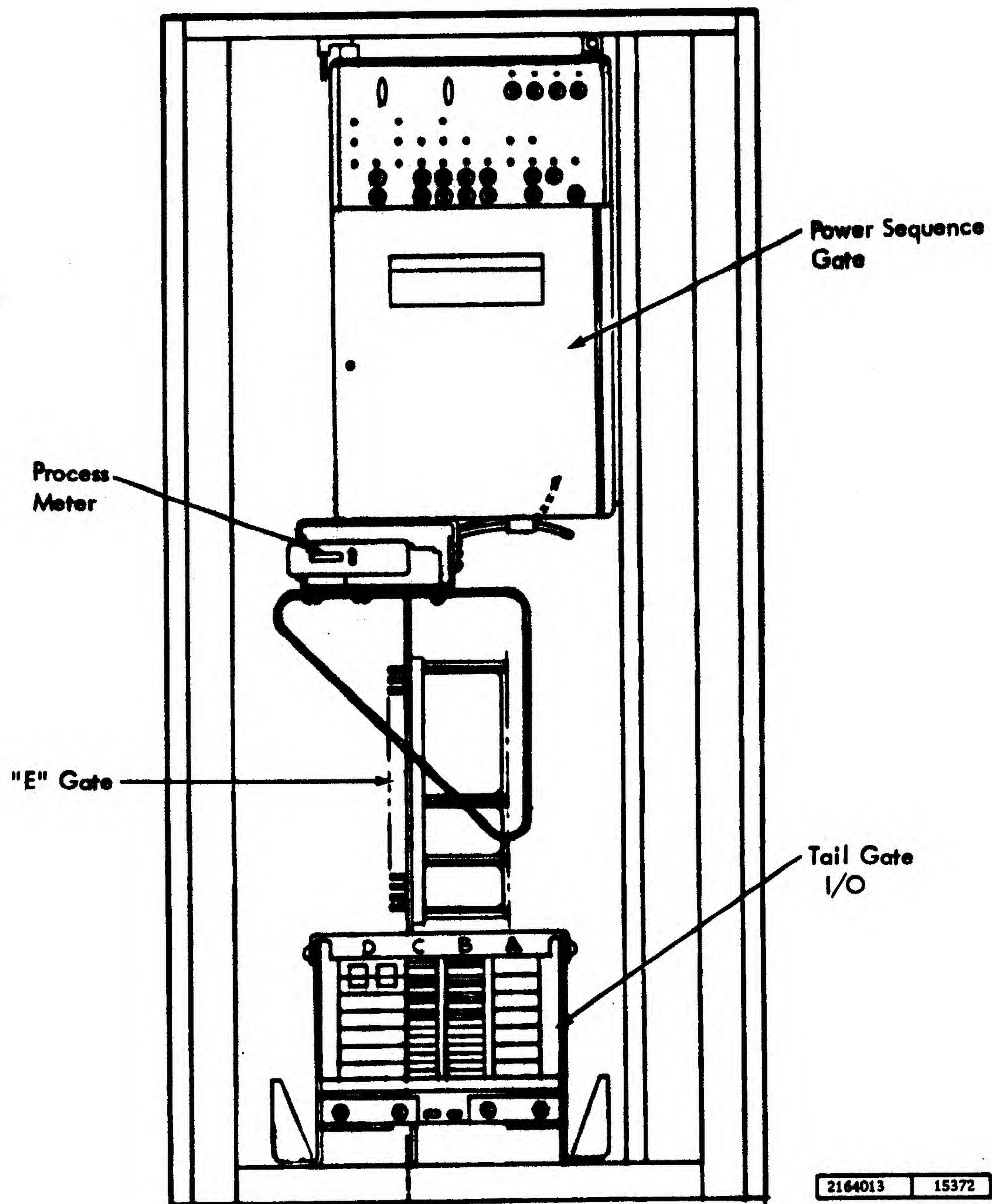
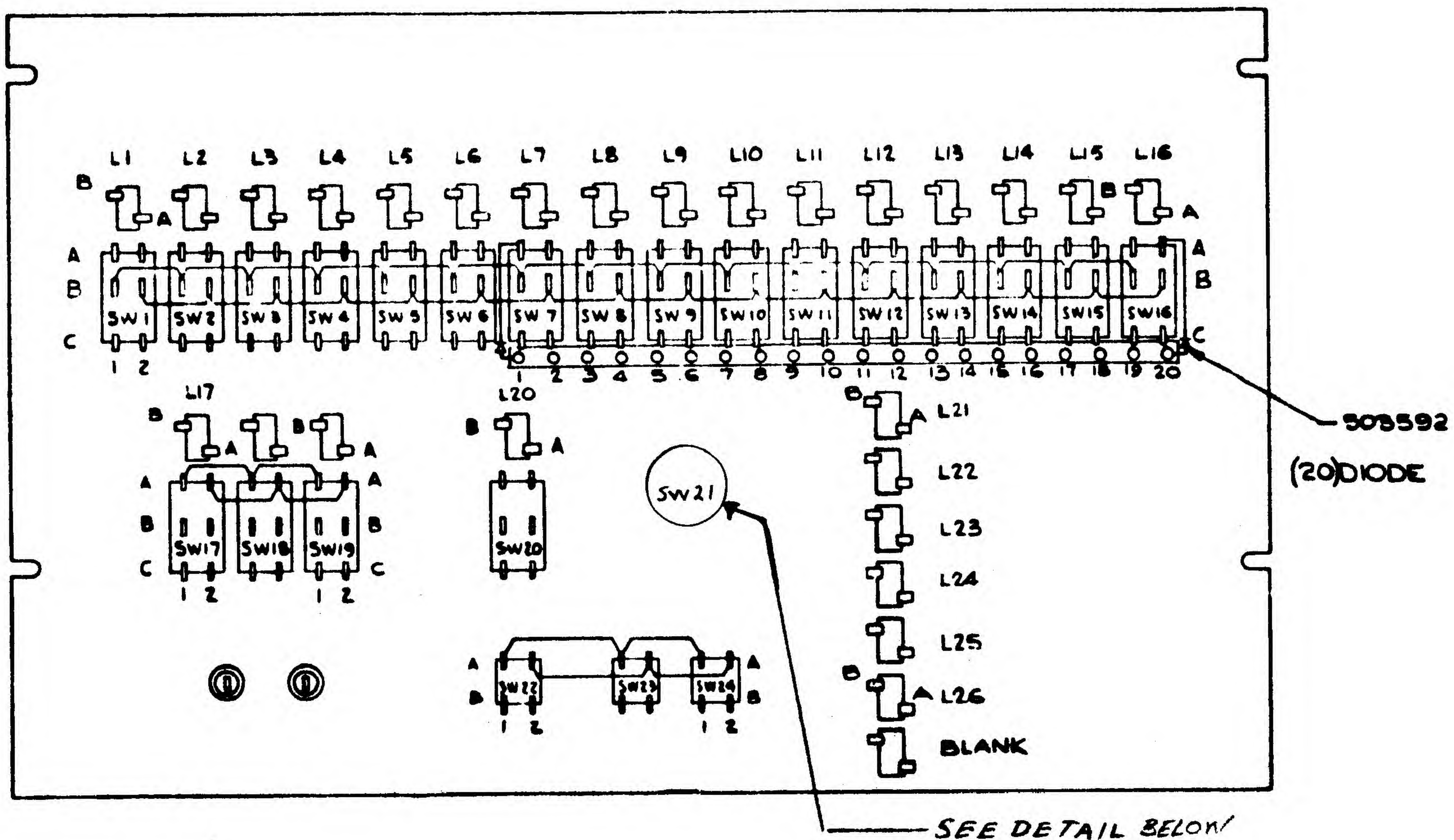


Figure 5-22 Electronic Frame -- Right End



VIED FROM WIRING SIDE

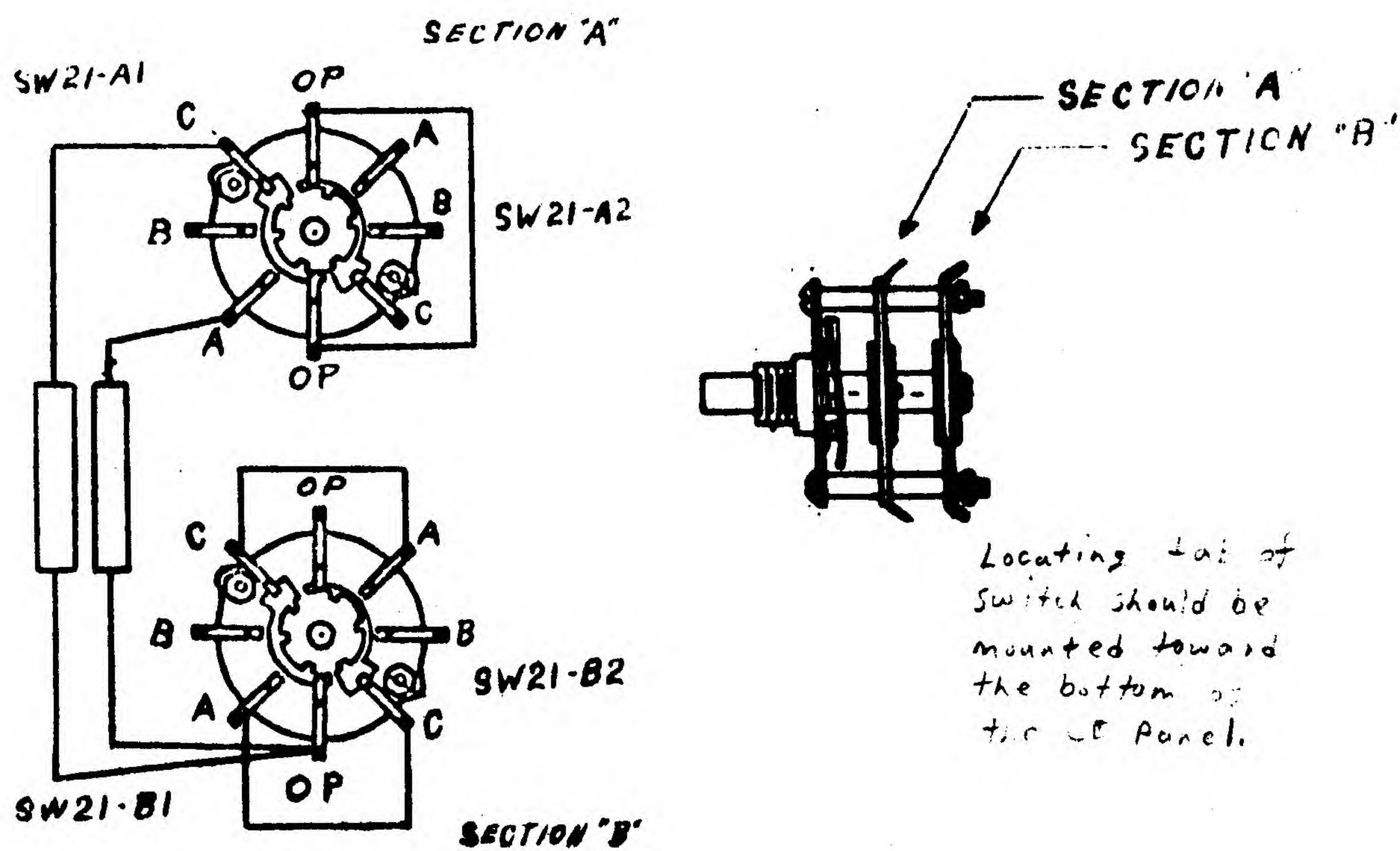
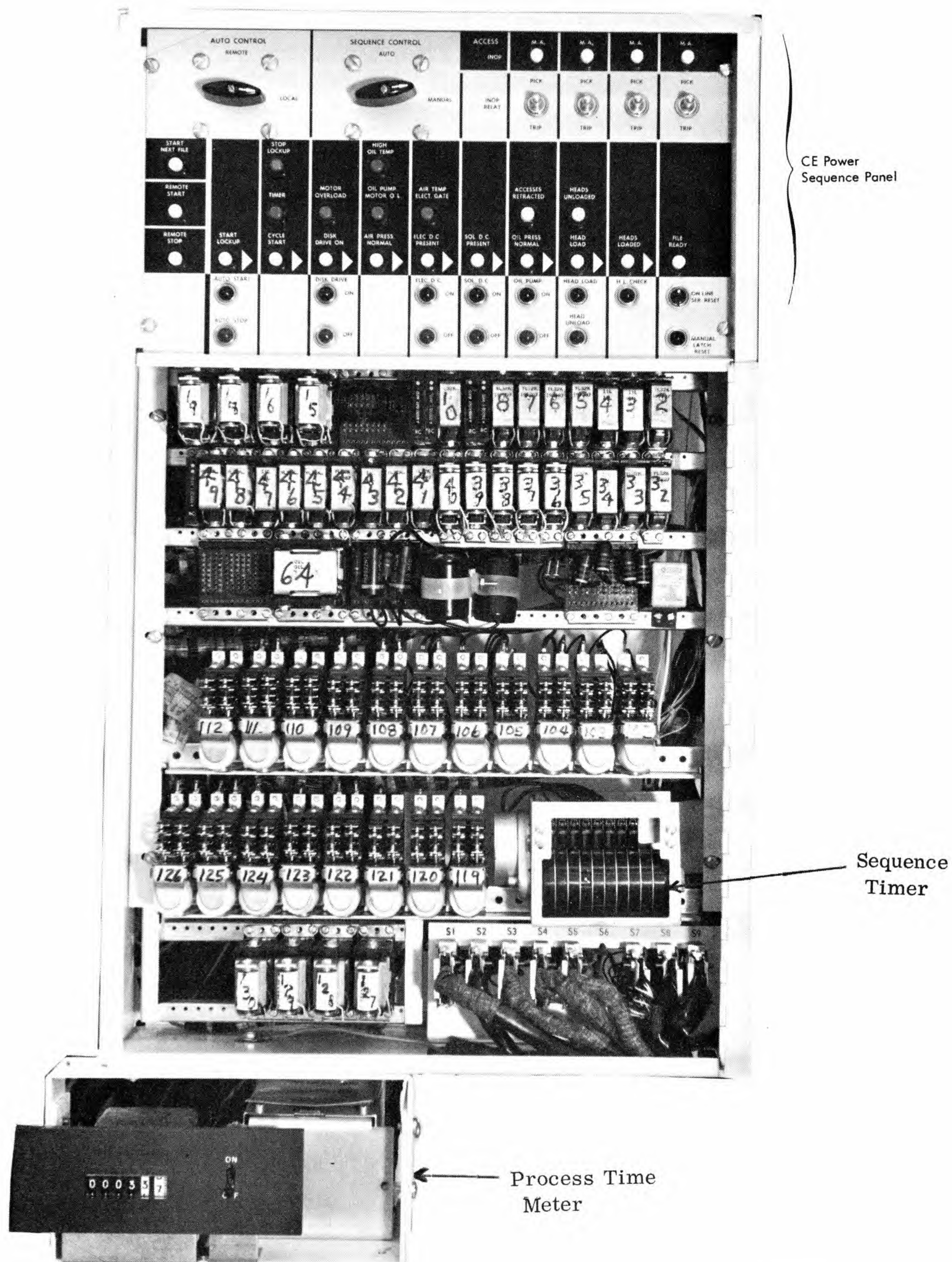


Figure 5-23 CE Panel Component Numbering

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Figure 5-24 Power Sequence Gate

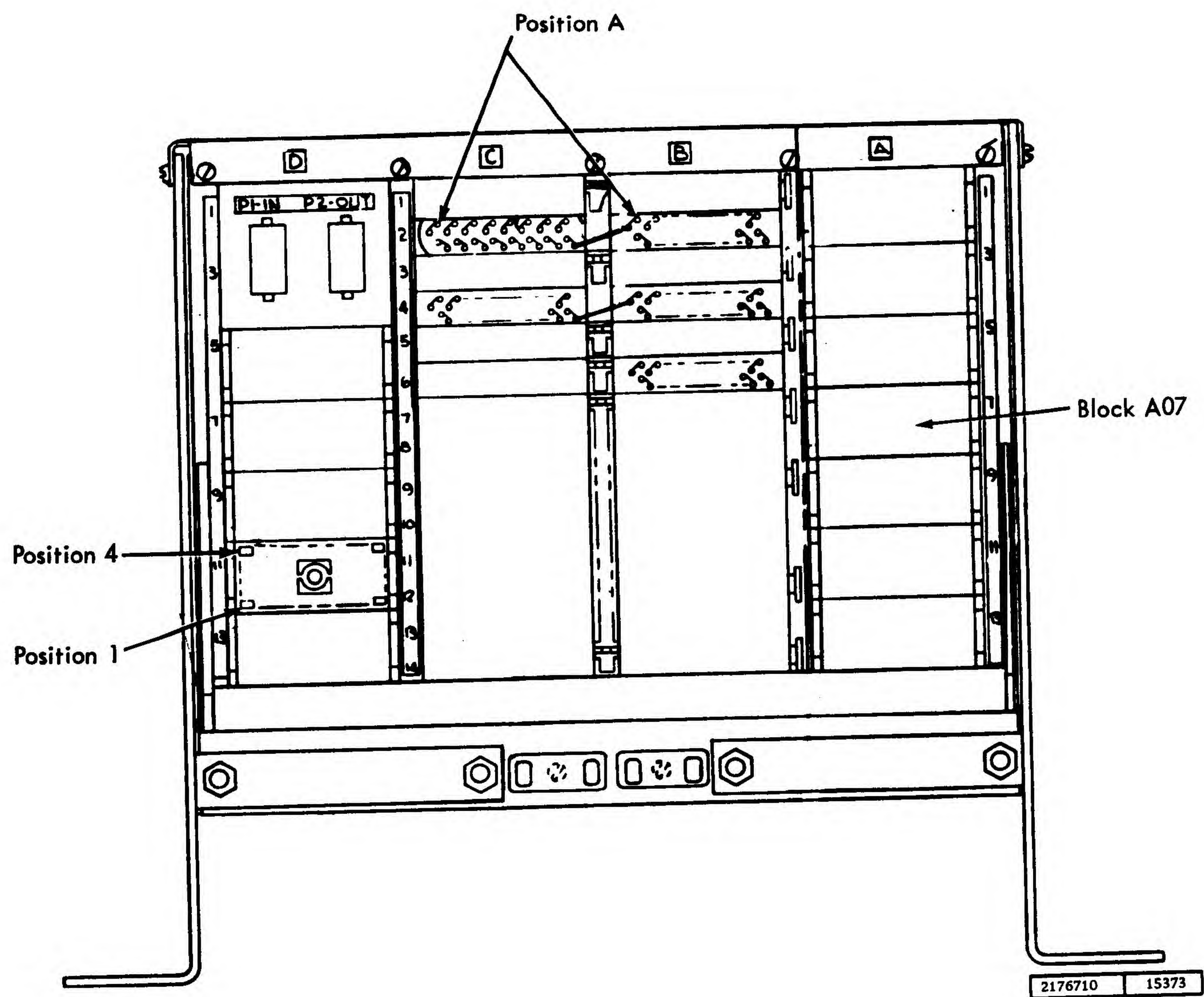
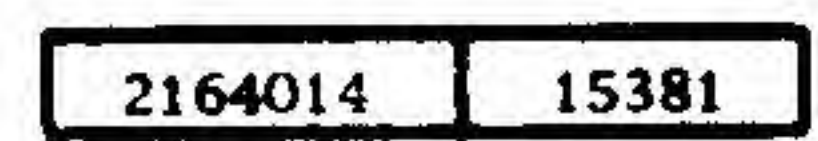
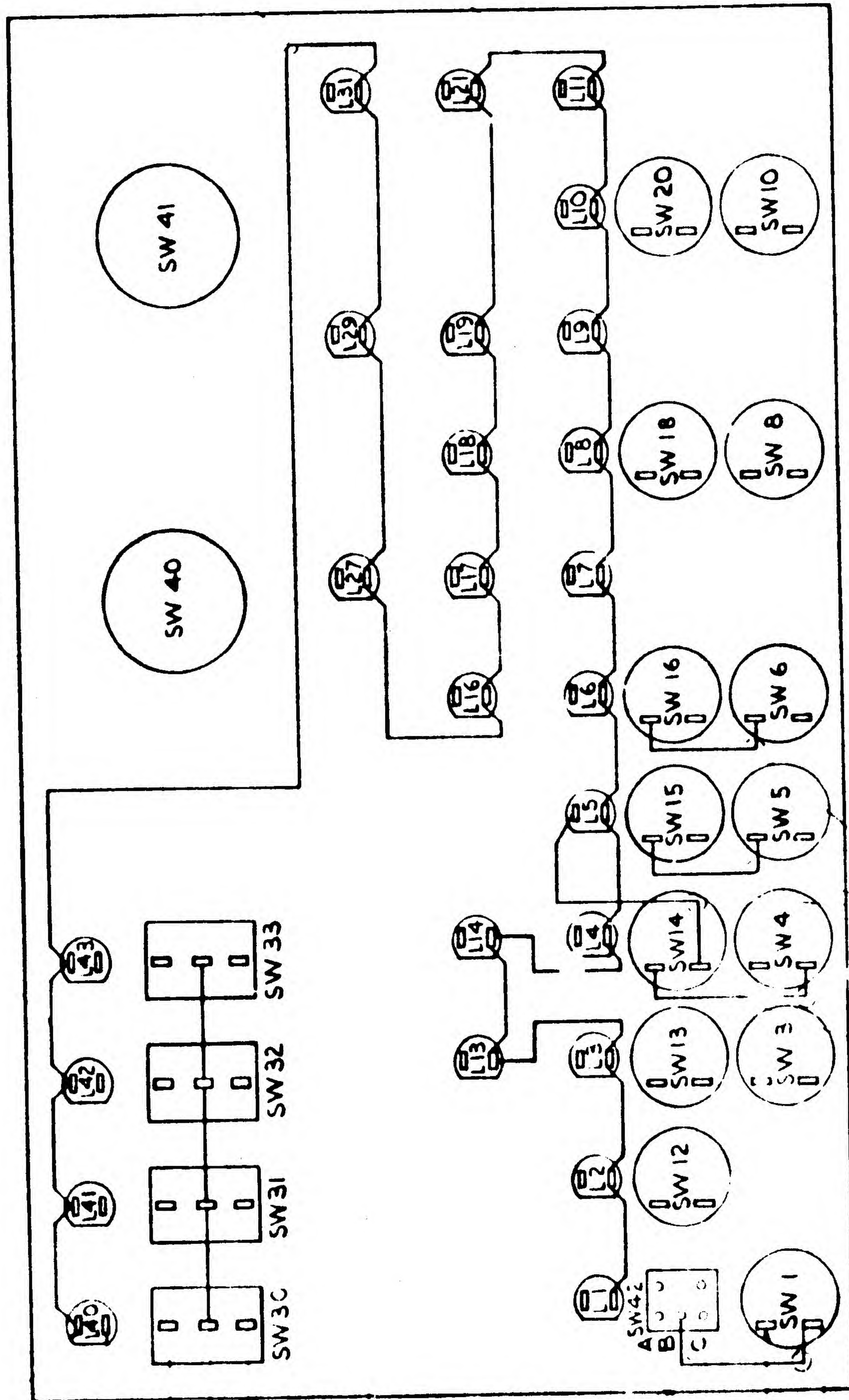


Figure 5-25 I/O Gate



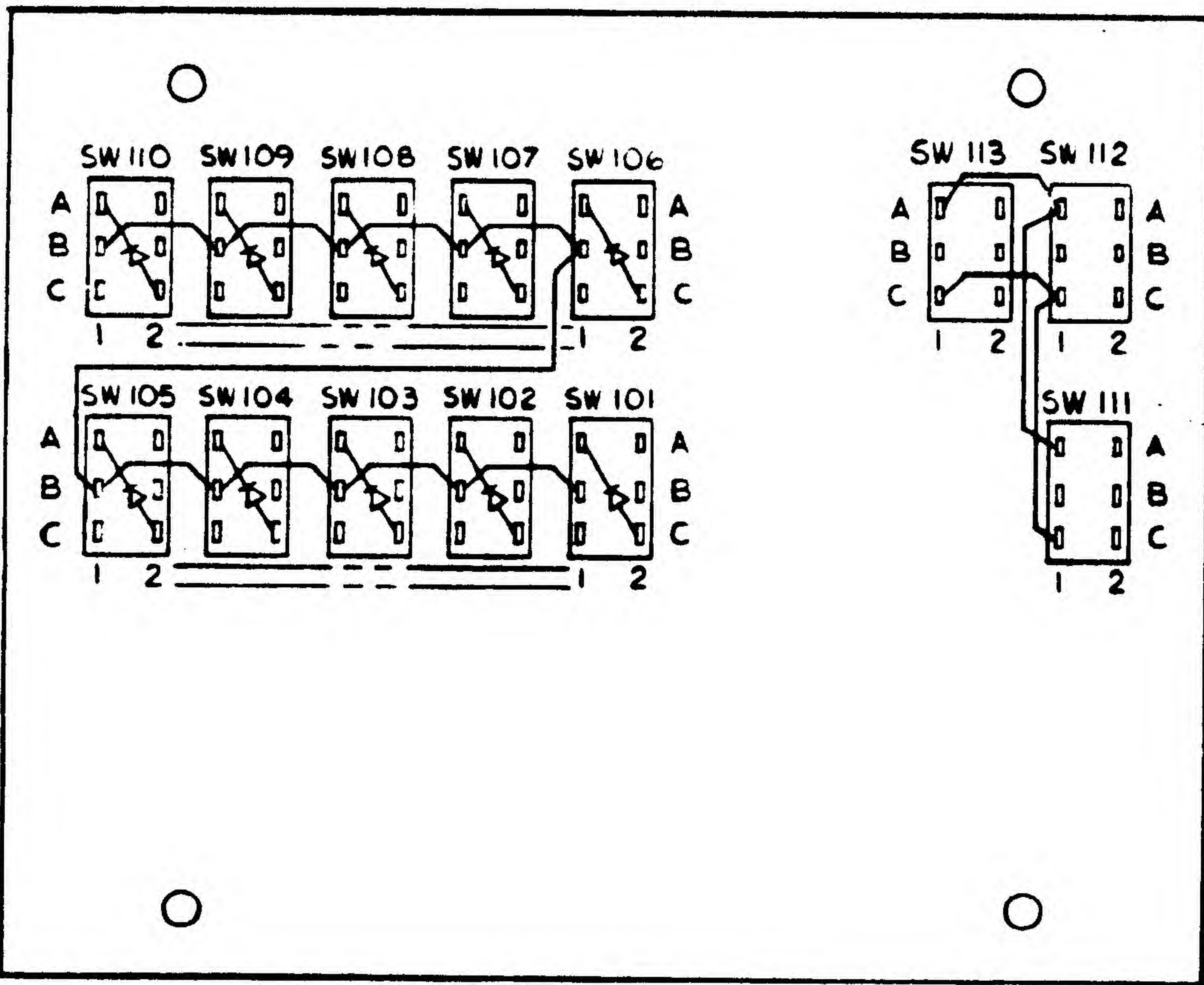
5.16



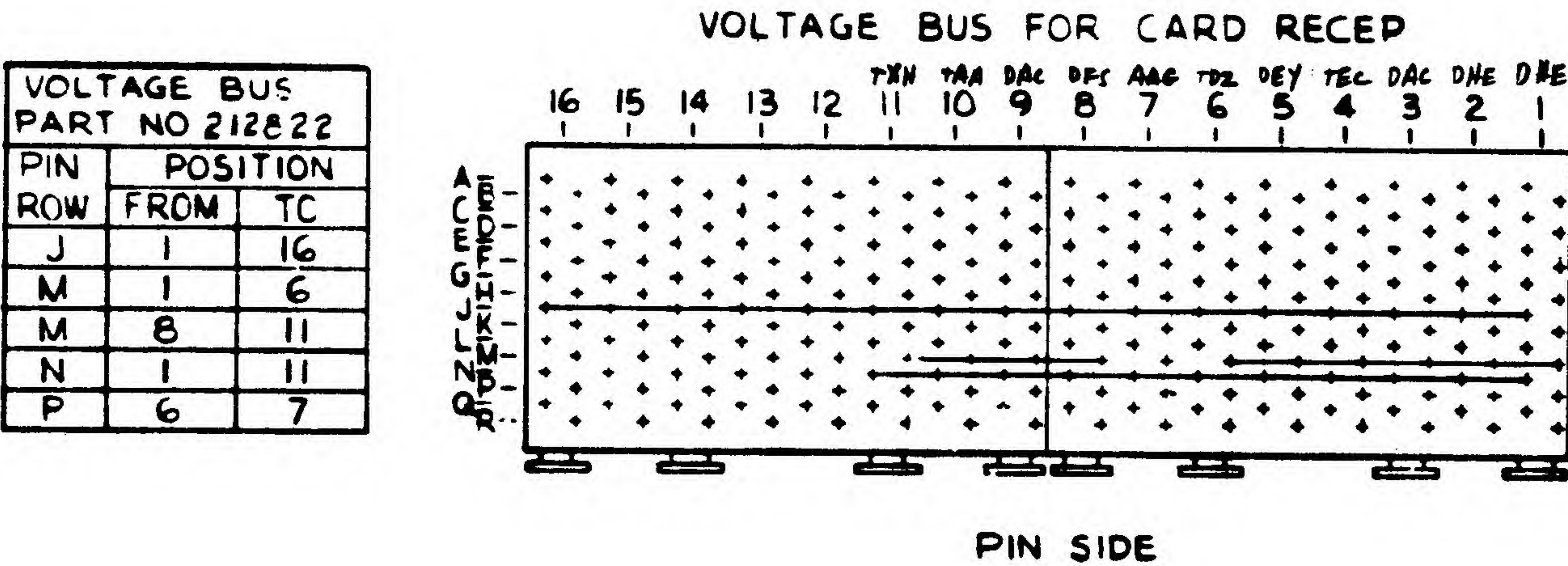
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Figure 5-27 Power Sequence Panel Component Numbering

Figures 5-28 and 5-29 (Deleted)



WIRING SIDE



PIN SIDE

Figure 5-30 Remote CE Box -- Component Numbering

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SECTION 6 ADDITIONAL FEATURES

The IBM 1302 Disk Storage is available in four models:

IBM 1302 Model 1 - 1 Disk Module, 2 Accesses

IBM 1302 Model 2 - 2 Disk Modules, 4 Accesses

IBM 1302 Model N1 - 1 Disk Module, 2 Accesses

IBM 1302 Model N2 - 2 Disk Modules, 4 Accesses

The 1302 Model 1 and 1302 Model 2 are controlled by the IBM 7631 File Control Unit. The 1302 Model N1 and 1302 Model N2 are controlled by the IBM 2841 Storage Control Unit.

A 1302 Model 1 may be field converted to a 1302 Model N1. A 1302 Model 2 may be field converted to a 1302 Model N2.



SECTION 7 SPECIAL TOOLS AND SUPPLIES

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7.2 Tools Available with System	7.2	7.5.3 Hydraulic Power Supply Replacement Kit	7.4
7.3 Office Tools and Supplies	7.2		
7.4 Tools for SMS Servicing.	7.3	7.6 (Deleted)	
7.5 Tools in Emergency Parts Centers	7.4	7.7 Marginal Check Unit	7.4
7.5.1 Disk Aligning Kit	7.4	7.8 Applicable Customer Engineering Manuals	7.5

7.1 SHIPPING GROUP (B/M 2164004)

This is a list of special tools and supplies that are sent with the machine from the plant. They should be kept with the machine.

Parts Catalog	Form 127-0785
CE Maintenance Manual	Form 227-5864
System Diagram Manual	P/N 2176716
Frame Joining Screw	10303
Nut Cable Clamp	11598
Nut Frame Joining	25793
Washer Kickstrip Mounting	45690
Washer Cable Clamp	45690
Screw Kickstrip Mounting	91611
Screw Cable Clamp	91611
Washer Frame Joining	161351
Lockwasher Frame Joining	257983
Force Gauge 6.5 lb	460870
Binder CE Manual	461176
Paddle Disk Cleaning	2108010
Syringe-Wiper Lubricating	2108790
Wrench Allen	2108467
Container Oil Drain	2108743
Container 5 gal.	2108744

Tool Kit	2108775
Box ASM Remote CE	2108788
Bracket Kickstrip Corner	2121110
Bracket Kickstrip Corner	2121111
Clamp Cable	2122374
Clamp Cable	2123024
Wiper Disk	2123106
Washer Frame Ground	2123127
Shipping ASM-Alcohol	2155966
Brace ASM	2192836
Drawer ASM Front Tool	2164250
Drawer ASM Rear Tool	2164251
Pan Oil Drip	2164576
Kickstrip Plain	2181501
Kickstrip ASM-Entry	2122373
Kickstrip ASM-Entry	2123123
Kickstrip	2121112
Plate-Blank Off	2164034
Remote Control Box	2108788
Gauge, Crash Stop	2108791

7.2 TOOLS AVAILABLE WITH SYSTEM

The following is a list of tools available for systems which use the 1302 Disk Storage Unit.

Tektronix 535 Oscilloscope and Accessories	P/N	460257
Tektronix Pre-Amp 53/54 CA	P/N	460999
Direct Coaxial Scope Probe (X1)	P/N	460852

7.3 OFFICE TOOLS AND SUPPLIES

The following is a list of tools and supplies normally located in the branch office. They can be obtained when needed.

Meter, Simpson	P/N	450497
Prefiltered Hydraulic Oil (in one gallon container	P/N	2115252
Vacuum Cleaner -- Hoover Model 86	P/N	NA
10" Adjustable Wrench	P/N	450177
Carriage Spacing Tool	P/N	2108576
Wrapped Wire Pistol Tool	P/N	461012
Torque Wrench and Accessory Kit (for shaft motor or actuator replacement)	P/N	2108470
Wrench - 5 to 150 In/Lbs Torque	P/N	2108435
Adapter - Actuator Torque	P/N	2108436
Socket 0.500"	P/N	2108464
Socket - Universal	P/N	2108466
Socket - 0.375"	P/N	2108478
Roll - Torque Kit Tool	P/N	2108481
Socket - 0.125" Hex	P/N	2108486
Lint Free Tissue	P/N	2123106
Burndy Extractor Tool Rx 20-10	P/N	461043
Solder Iron Tip-SMS Pin Removal	P/N	451111
Replacement Plunger	P/N	451113
Marginal Check Power Supply	P/N	210860
Wrapping Bit, Wire Size #24	P/N	461235
Sleeve, Wire Size #24	P/N	461015
Hand Crimping Tool	P/N	450898
Wire Stripper	P/N	450694
Wire Gage	P/N	461076
#24 Gage Solid Tinned -- Copper Wire	P/N	216226

7.4 TOOLS FOR SMS SERVICING

The following is a list of tools and supplies that are not shipped with the machine, but are recommended for each installation.

Hand Un-Wrap Tool	P/N	451573
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Card Extender -- Cable Isolation Tool	P/N	451075
SMS Card Contact Lubricant	P/N	451053
SMS Card Insertion -- Extraction Tool	P/N	451030

7.5 TOOLS IN EMERGENCY PARTS CENTERS

The following is a list of tools available in all Emergency Parts Centers. They can be obtained when needed.

7.5.1 DISK ALIGNING KIT P/N 2108433

This kit contains special disk replacement tools, but does not contain replacement disks.

Included in this kit is a special flashlight. However, due to the decay factor inherent in dry cell batteries they are not shipped with the light. Obtain two type AA pen light batteries locally.

7.5.2 HOIST FOR SHAFT MOTOR KIT B/M 2108247

When replacing a shaft motor, the Hoist for Shaft Motor Kit (B/M 2108247), Disk Alignment Kit (B/M 2108433) and Shaft Motor and Instructions (B/M 2115248) must be ordered from the E.P.C. Special tools required for motor replacement will be shipped with the shaft motor.

7.5.3 HYDRAULIC POWER SUPPLY REPLACEMENT KIT

This kit contains a complete hydraulic power supply, including fluid with the equipment necessary to remove the used unit and install the new unit. The container for this unit serves the dual purpose of a shipping crate and a dolly platform to assist in the removal of the used unit and installation of the new unit.

7.5.4 Clock Writer

The clock write box is available to rewrite the clock on 1302 machines if the clock disk is replaced with a new disk or if the clock tracks become misaligned due to disk restacking.

7.6 (Deleted)

7.7 MARGINAL CHECK UNIT (P/N 210860)

The marginal check unit (MC) is a special self contained power supply with a variable output voltage. When plugged into the

Marginal Check jack (Figure 5-2), this unit is placed in series with the +12v supply and permits the Customer Engineer to change the +12v a maximum of +3 volts.

WARNING: The Marginal check power supply may be damaged if the MC voltage is not at zero (or OFF) when the jack plug is inserted or removed.

7.8 APPLICABLE CUSTOMER ENGINEERING MANUALS

This is a list of CE manuals that contain information that is of value in servicing the IBM 1302 Disk Storage.

MANUAL NAME	TYPE	FORM NUMBER
IBM 1302 Disk Storage	CEMI	227-5863
IBM 1302 Disk Storage	CEMM	227-5864
IBM 1302 Disk Storage	CEILD	227
IBM 1302 Disk Storage	PC	127-0785
Standard Modular System	CEIMM	223-6900
Tektronix Oscilloscopes	CEMI	223-6725
Transistor Component Circuits	CEMI	223-6889
Transistor Theory Illustrated	CEMI	223-6794
Transistor Theory and Application	CEMI	223-6783
60 Cycle SMS Power Supplies	CEMI	225-6478
IBM 7631 File Control	PC	123-0463
IBM 7631 File Control	CEIMM	223-2766
IBM 2841 Storage Control	CEMM	227-5925
IBM 2841 Storage Control	CEMI	227-5901
IBM 2841 Storage Control	PC	127-0793

CEMI = Customer Engineering Manual of Instruction

CEMM = Customer Engineering Maintenance Manual (Formerly Reference Manual)

CEIMM = Customer Engineering Instruction - Maintenance Manual

CEISD = Customer Engineering Instructional System Diagrams

PC = Parts Catalog

CEILD = Customer Engineering Intermediate Level Diagrams

CES = Customer Engineering Supplement

SECTION 8 ANALYSIS GUIDE AND SERVICE INDEX

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8.2.2.1 Rezero can be Caused By	8.5	8.2.11 Bit Cell Time	8.8
8.2.2.2 Rezero Coming On Will	8.5	8.2.12 Format Track	8.9
8.2.2.3 Rezero Reset	8.5	8.2.13 Write Data	8.9
		8.2.14 Read/Write Circuit Description ...	8.9

8.1 TROUBLESHOOTING HINTS

WARNING: Voltage is present on both sides of most circuit cards. Metal caps of transistors are often a part of the circuit. Avoid pulling or replacing cards with the DC on, since a resultant short could damage transistors or other circuit components.

WARNING: Solenoid Drive No. 2 (TDR-) must never have -48v on it alone. If this card is removed from the gate there is a possibility of having this condition. Solenoid dc and Electronic dc must be turned off prior to removing this card.

Intermittent problems can sometimes be aggravated by vibration. Tapping the edge of the cards with the plastic end of a screw driver in the area suspected should be sufficient. Caution is required since too violent vibrations can cause adjacent card components to short.

There will arise instances where it is desirable to jumper in signals or voltages to specific inputs or outputs to check certain functions. Care should be taken that the logic blocks are not overloaded because of this, as erroneous indications will result. More important is the use of voltages that can damage or destroy the transistors. For the majority of logic block cases, a properly placed ground will create the effect desired. All other cases must be treated individually based on knowledge of the circuits involved.

Special circuit card diagrams are shown in the system diagrams. Also shown are input and output waveforms for most of these cards.

Most S levels may be clamped to ground without damage to the circuit card (DFK- and AEK-cards are the exceptions to this rule).

8.1.1 READ MALFUNCTIONS

WARNING: Do not put scope probes, leads, or jumpers of any kind on the lines coming directly from the data or format heads. The heads can be damaged and/or data destroyed by possible potential differences.

1. Failure of the read amplifier to reject line noise can be caused if the receiver is not electrically isolated from frame ground (minimum of one megohm resistance).

The receiver assembly must be electrically dc isolated from frame ground by at least 50,000,000 ohms and is to be connected to the J pin of the read filter card (TXD- at 5A08).

The shields of the format head cable must be connected to the J pin of the format pre-amplifier card (TXT- at 5C08). The access end of the shields must be tied together and connected to the format drawer shield.

2. Data Read failures can be caused by a defective data read amplifier.
 - a. The pulse width of the output (Pin E) of detector (ECK- at A5B10) must be 125 NANO seconds plus or minus 10% measured from the 10% up on leading edge to 10% down on trailing edge.
 - b. The peak-to-peak signal at the input to the pre-amplifier (SLT) for any data configuration should not be less than 1.0 millivolts. This applies to customer cylinders only.
 - c. The Amplitude ratio of 1F (clock bits only) to 2F (clock and data bits) should not exceed 3 to 1.
3. Examples of proper read amplifier signals are shown in Section 8.2.14. Signal polarity is dependent on the probe connections and the recorded signal.
4. Read failures can be caused by heads not being fully loaded. This condition causes all heads of a module to have decreased output. In this case the heads loaded microswitch would also have to be in incorrect adjustment.
5. Format read failures can be caused by a defective format read amplifier.
 - a. The peak-to-peak signal at the input to the Pre-Amplifier TXT- for any data configuration shall not be less than 7 millivolts or more than 50 millivolts. This applies to customer cylinders (single access file only).
 - b. The DC levels (no signal) at pins H and G or TP1 and TP2 of the Overdriven and Limiter Amplifier (TEN-) are to be within .1 volts of each other. Use the potentiometer on this card for adjustment.

- c. The output of the second Linear Amplifier (TEH-) following the variable gain Amplifier (TEV-) is to be 6.25 volts ± 0.25 volts (with signal) peak-to-peak. Use potentiometer on the variable gain amplifier for adjustment.
- d. Set the clipping level to 50% by observing pin A of the OR-AND. See Figure 3. Use potentiometer of this card for adjustment.

8.1.2 WRITE FAILURES

An apparent failure to write can be caused by a write safety circuit malfunction. Check for proper write safety conditions before investigating a write driver or write head for trouble (Section 8.2.8).

8.1.3 READ/WRITE FAILURES

1. The voltage safety card protects both read and write circuits. Check this card when neither read nor write operations function.
2. Failure of clock read circuit may cause excessive bit shift to be stored on format which could cause data errors.
3. Incorrect adjustment or loosening of the carriage yoke assembly can cause read or write failures.
4. The input voltage must remain within plus or minus 10%. This tolerance includes any variable combination of steady state and/or short duration transients.
6. The selection of multiple write X circuits is detected as an error, however, the selection of multiple read X and multiple Y circuits is not. Problems in this area cause simultaneous selection of heads and are difficult to diagnose.

8.1.4 ACCESS MALFUNCTIONS

1. There is no blown fuse indication on the 1302. Failure to go to the correct cylinder can be caused by a blown fuse.
2. Access failure can be caused by the access door being partially open or failure of the interlock.
3. Failure of the motion oscillator to switch to slow speed can cause the access to be set inop when the hydraulic oil is cold.

4. Excessive access time can be caused by failure of the oscillator to switch to high speed.
5. Extraneous rezeros can be caused by:
 - a. Improper hydraulic power supply temperature regulation.
 - b. Improper accumulator valve cut-in on overlapped seeks.
 - c. Clogged actuator bleeder lines to sump.
 - d. Motion timings.
 - e. Improper clearance of the motion rack to its transducer resulting in erroneous detent safety conditions at detent time.
 - f. Gib out of adjustment or dirty carriage ways and wiper pads.
 - g. Loose or improper yoke and tie bar adjustments causing the carriage to bind.
 - h. Improper hydraulic power supply pressure or clogged filters.

NOTE: Clogged filters can also cause overheat problems in the hydraulic power supply.

6. Use the following technique if a stuck hydraulic valve is diagnosed in the actuator.
 - a. Pick and drop solenoid of stuck valve from CE panel as rapidly as possible 50 to 100 times.
 - b. If step "a" frees the valve, select solenoids from CE panel to move carriage to all track positions before returning to normal operation.
 - c. If step "a" fails to free the valve, replace actuator. returning to normal operation.

Actual internal repairs and adjustments are not allowed. If actuator proves to be defective, it is to be replaced.

8.2 SERVICE CHECKS

8.2.1 ATTENTION STATUS

Attention status is reset by the leading edge of the module select and access-select signal if an end-of-seek signal is present.

Attention status is raised and driven to the system when any of the following conditions occur:

1. Access becomes Ready.
2. End Rezero comes up (56 count, outer limit stop, rezero).
3. 60 count comes up.

8.2.2 REZERO

8.2.2.1 Rezero can be caused by:

1. CE Rezero.
2. Power sequence Rezero.
3. Arrival failure.
4. Invalid address (all globs).
5. Hitting the inner limit switch when not addressed to cylinder 250.
6. Opening access cover door.

8.2.2.2 Rezero Coming On Will:

1. Set the Access Register to 0000.
2. Pull detent after initial drive (except if access cover door open).
3. Energize Rezero valve.
4. Return to outer CE cylinder at rezero force (except if access cover door open).
5. Re-calibrate the oil.
6. After the actuator has returned to the outer CE cylinder, the oil is recalibrated for the required length of time, then attention status is raised.

8.2.2.3 Rezero Reset

To reset rezero when off-line, push CE reset. This will turn off Rezero and cause access to detent at cylinder 00. When on-line, a seek instruction will set the detent at 00.

8.2.3 ACCESS COVER SAFE SWITCH

When the access cover door (01.06.15.1) is opened or removed, this switch will open and cause:

1. The access to be set INOP.
2. The Access Register Cylinder Address set pulse to be blocked (from system).
3. Rezero to be held on.
4. Access Register to be held reset.
5. The detent to be held in.

CAUTION: If solenoid dc is dropped for any reason the actuator may attempt to move under hydraulic pressure.

8.2.4 DC VOLTAGES

1. The 48v relay supply must be a minimum of 42.6v and a maximum of 50.4v.
2. The dc SMS supply voltages must be within + - 2% rated output voltage at the laminar bus on the gates.
3. The machine should perform all normal functions with the +12 volt marginal voltages varied between +9 volts and +12 volts.

8.2.5 PULSE WIDTH OF SINGLE SHOTS

WARNING: Adjustment of single shots should only be made while actuator is stationary and under CE control.

8.2.6 ACCESS INOP

Access inop can be caused by:

1. Access cover door open or off.
2. System set-access-inop signal.
3. 60 count comes up.
4. Access not retracted at head load time of start sequence.
5. Heads not loaded at head load check time of start sequence.

8.2.7 POWER SEQUENCE CONTROL

The proper starting sequence of file components under AUTOMATIC LOCAL and AUTOMATIC REMOTE operation, after a "heads unloaded" and "Air Pressure Normal" indication is:

1. Cycle start.
2. Disk drive and electronic gate blowers.
3. Electronic dc, Solenoid dc, and start next file (remote only).
4. Oil pump.
5. Head load M0.
6. Head load check M0 and head load M1.
7. File ready and head load check M1.

An access is set INOP during the starting sequence if:

1. The access is not retracted at head load time.
2. The heads are not loaded at head load check time.

8.2.8 READ AND WRITE SAFETY CIRCUITS:

Read Safety

1. Pin D of 01AlF14 on system diagrams page 01.01.04.1 should be -C when neither Write Gate nor Erase Gate is enabled, and no Write Driver or Erase Driver output transistor is conducting.
2. Read Safety should fall within 16 microseconds after the rise of Write and Erase Gate. (Both must be present before timing begins).
3. Read Safety and Write Safety should only be on together, following a write operation, between the time from the fall of Write Gate and the fall of Erase Gate. This is an error condition at any other time.
4. The controlling system should monitor Read and Write Safety Lines to assure each is in their proper condition prior to any file operation.

Write Safety

1. Pin E of 01AlF01 on system diagrams page 01.04.01.1 should be -C when either Write Gate or Erase Gate is enabled, or when any one Write driver or Erase driver output transistor is conducting.
2. Write safety should rise within 16 microseconds after the rise of either Write Gate or Erase Gate.

3. Write Safety should fall within 16 microseconds after the fall of both Write and Erase Gate.

8.2.9 (Deleted)

8.2.10 (Deleted)

8.2.11 BIT CELL TIME

Bit Cell time is defined as 800 NANO Seconds plus or minus motor speed variations measured from clock bit to clock bit with data bits evenly spaced between clock bits. There will be magnetic bit shift due to magnetic displacement. There are five basic bit patterns which have different bit shift specifications. They are shown in Figure 8-3.

8.2.12 FORMAT TRACK

There is a format track written which consists of a series of combinations of all bits and no bits. These combinations consist of a specific number of all bits and no bits. These bits are written approximately 1.6 microseconds apart and only vary with motor speed. The format track is written with respect to the clock track.

- a. This format is written on the file format at cylinders 222 and 250 for all four actuators with the layout shown in Figure 8-4.

8.2.13 WRITE DATA

1. Pulse Width -- 100 to 140 nano seconds. Measured from 10% up to 10% down.
2. Pulse rise time - 15 nano seconds (max.)
3. Pulse fall time - 35 nano seconds (max.)
4. There shall be no more than + - 10 nano seconds bit shift from any bit to any adjacent bit.

8.2.14 READ/WRITE CIRCUIT DESCRIPTION

Complementary Emitter Follower

The complementary emitter follower provides the necessary low impedance and proper voltage levels required to drive the write driver.

The input pins A and B accept the Y-level output of the Write trigger. For a typical operation, the output voltage at pins D and C is either -21 volts or -24 volts. If pin A is at a -Y level, the output at pin D is -31 volts and pin B will be at +Y level causing output pin C to be -24 volts.

Write Driver

The write driver provides current pulses to the write element. Gating and safety provisions are also included.

Write data from the complementary emitter follower stage are applied to pins D and N in opposite phases. In write operation, the write gate at pin C is at -Y level. When either pin D or pin N is at -21 v, write current is available to the write element of the head through its associated drive pin (A or G). Likewise, a voltage level of -24v at either pin D or pin N blocks the current flow from its associated pin (A or G) to the write element. If a not write condition exists, the write gate at pin C is 0v. The write current can be increased by connecting pin B to -36v supply. The output at pin F is used for multiple write driver selection safety check; ehe level is at -24v while writing.

Erase Driver

The erase driver provides the necessary driving power required when the head is selected for erase operation.

The gate input to Pin G is a standard S level. When the input at Pin G is at -S level, current is allowed to flow from the center tap of the magnetic head (+12v) to the erase coil through Pin H of the erase driver. The erase current has a relatively long rise and fall time (5 u sec.) to prevent transient currents from erasing information on the adjacent channels. The output transistor at Pin A is "off" when the erase current is "on" for muleiple safety check.

Pre-Amplifier

The pre-amplifier is a differential amplifier, consisting of an emitter follower stage, an amplifying stage, and an output stage which is capable of driving a 93 ohms coaxial cable. The circuit provides a high input impedance and rejects common mode signal to a high degree and amplifies the head signal from 100 KC to 2.5 MC with a gain of approximately 3. The pre-amp can be deselected by changing the voltage level at Pin G7 from -12v to 0v.

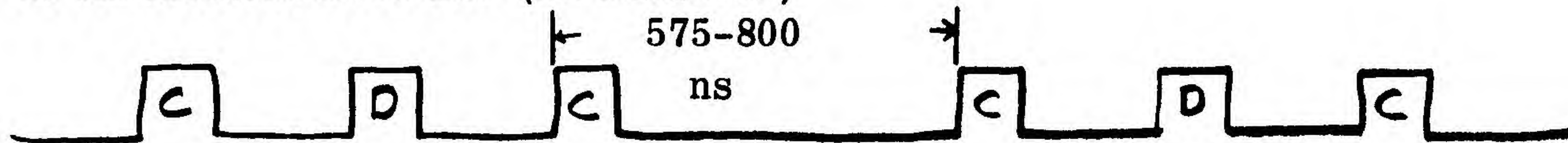
The pre-amp is used in conjunction with 1302 matrix and filter differentiator.

Filter-Differentiator

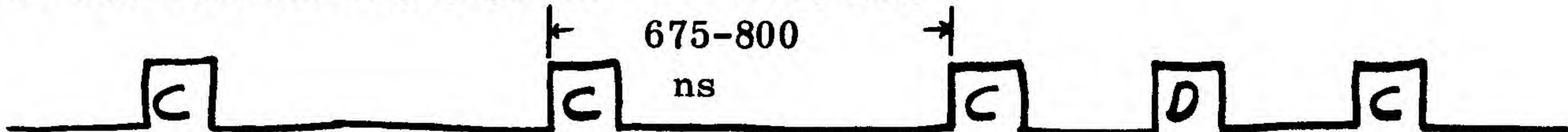
The filter-differentiator consists of a current source driving a low pass Butterworth filter, an emitter follower stage, and a differentiating stage.

The differential input signal is applied either at pins D and C or pins A and E, depending on which pre-amplifier in the 1302 is selected. A three section low pass Butterworth fileer represents the load for the first stage which has a gain of approximately 5.5. The bandwidth of the filter is 2 MC and it rolls off at

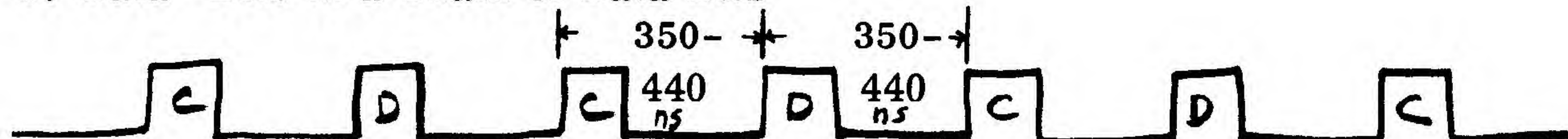
1. An Isolated Zero Bit (No Data Bit)



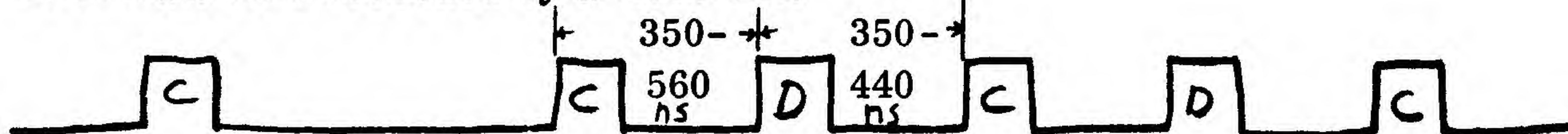
2. The Last Bit Of a Chain of Zero Bits



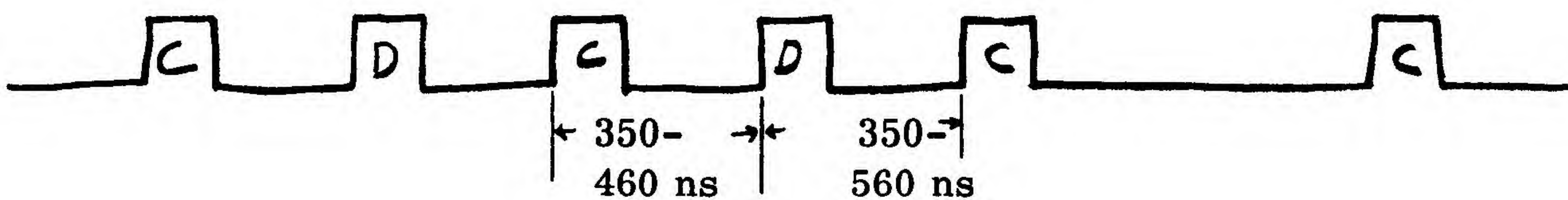
3. Data Bits in a Chain of Data Bits



4. A Data bit Preceeded by a Zero Bit.



5. A Data Bit Preceeded by a Data Bit and Followed by a Zero Bit.

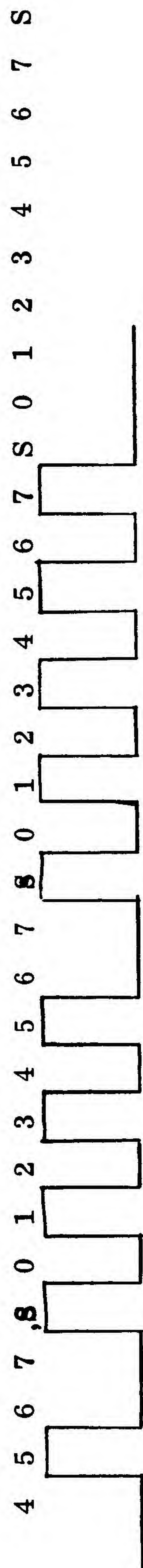


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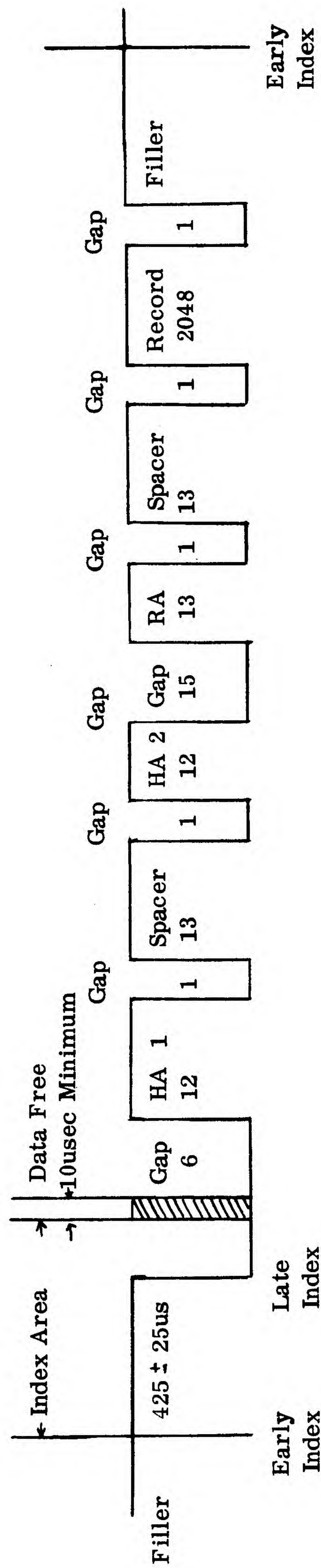
Figure 8-3 Basic Bit Patterns

Figure 8-1 (Deleted)

Figure 8-2 (Deleted)



Character Bit Pattern



All area numbers not labeled are 7631 characters.

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Figure 8-4 Format Track Configuration

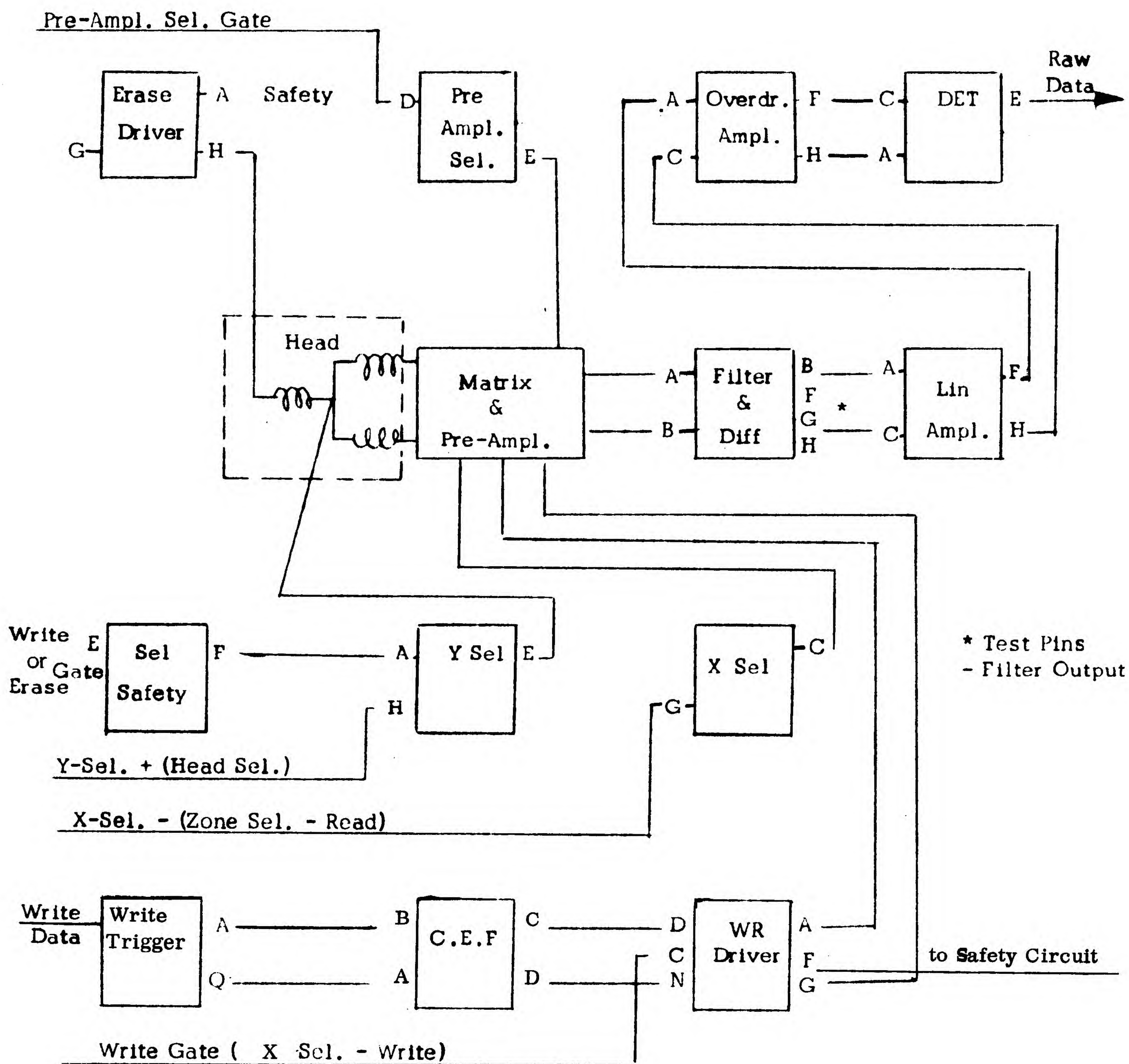
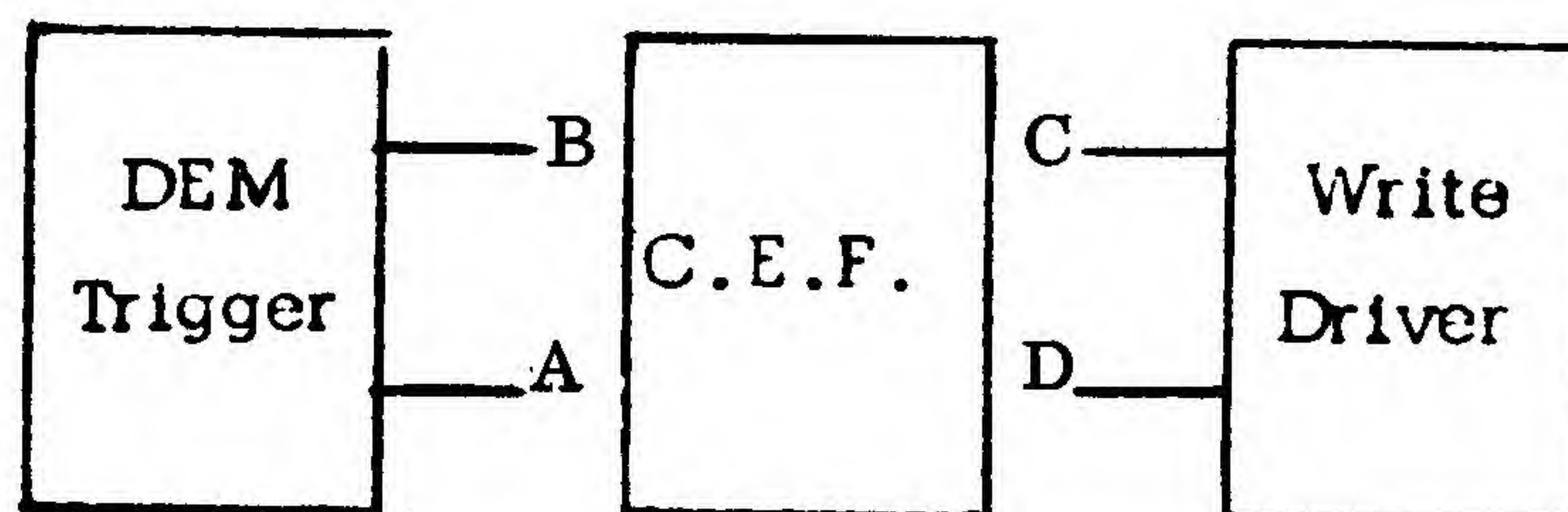
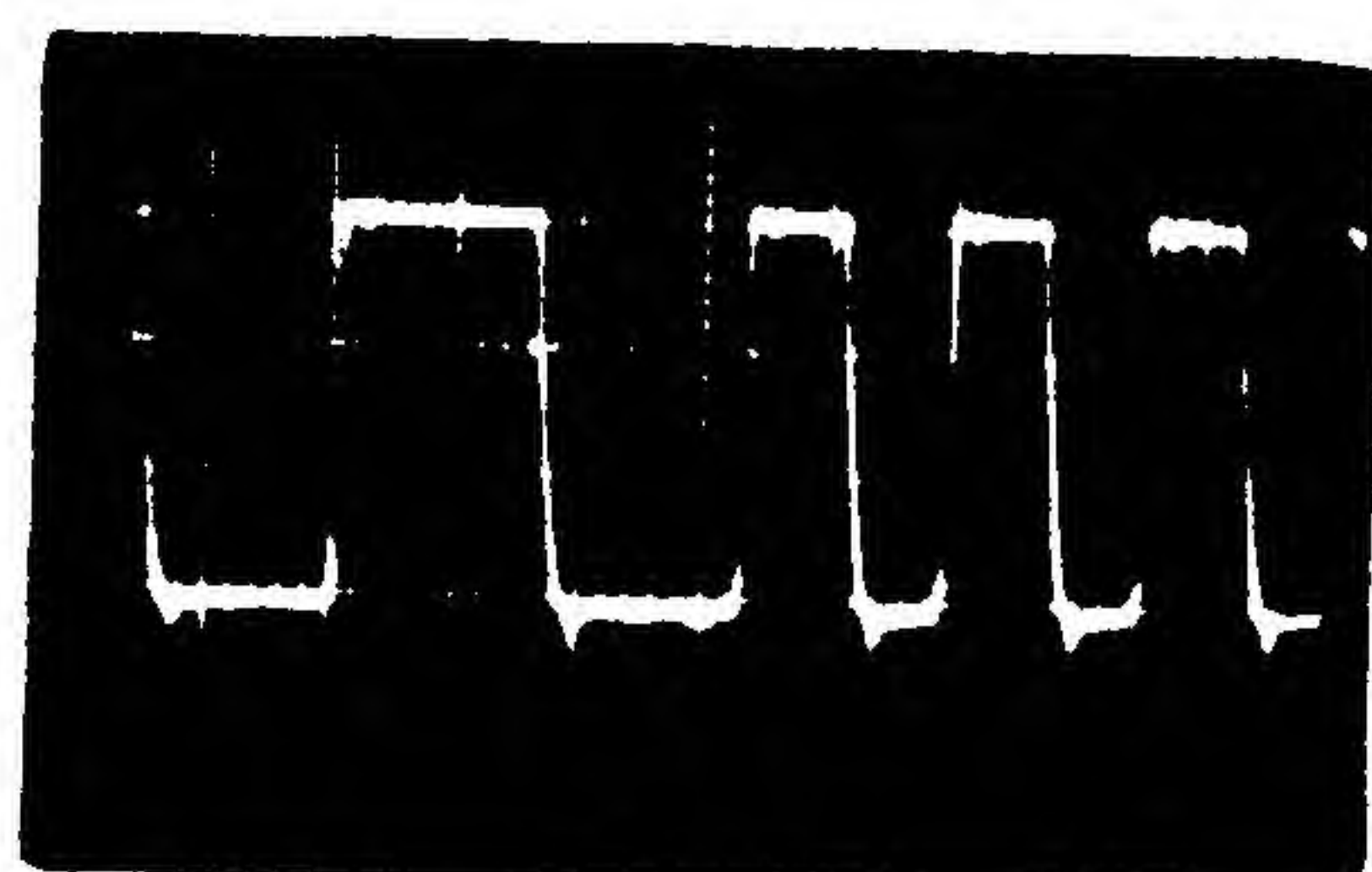


Figure 8-5 1302 Read/Write Circuits

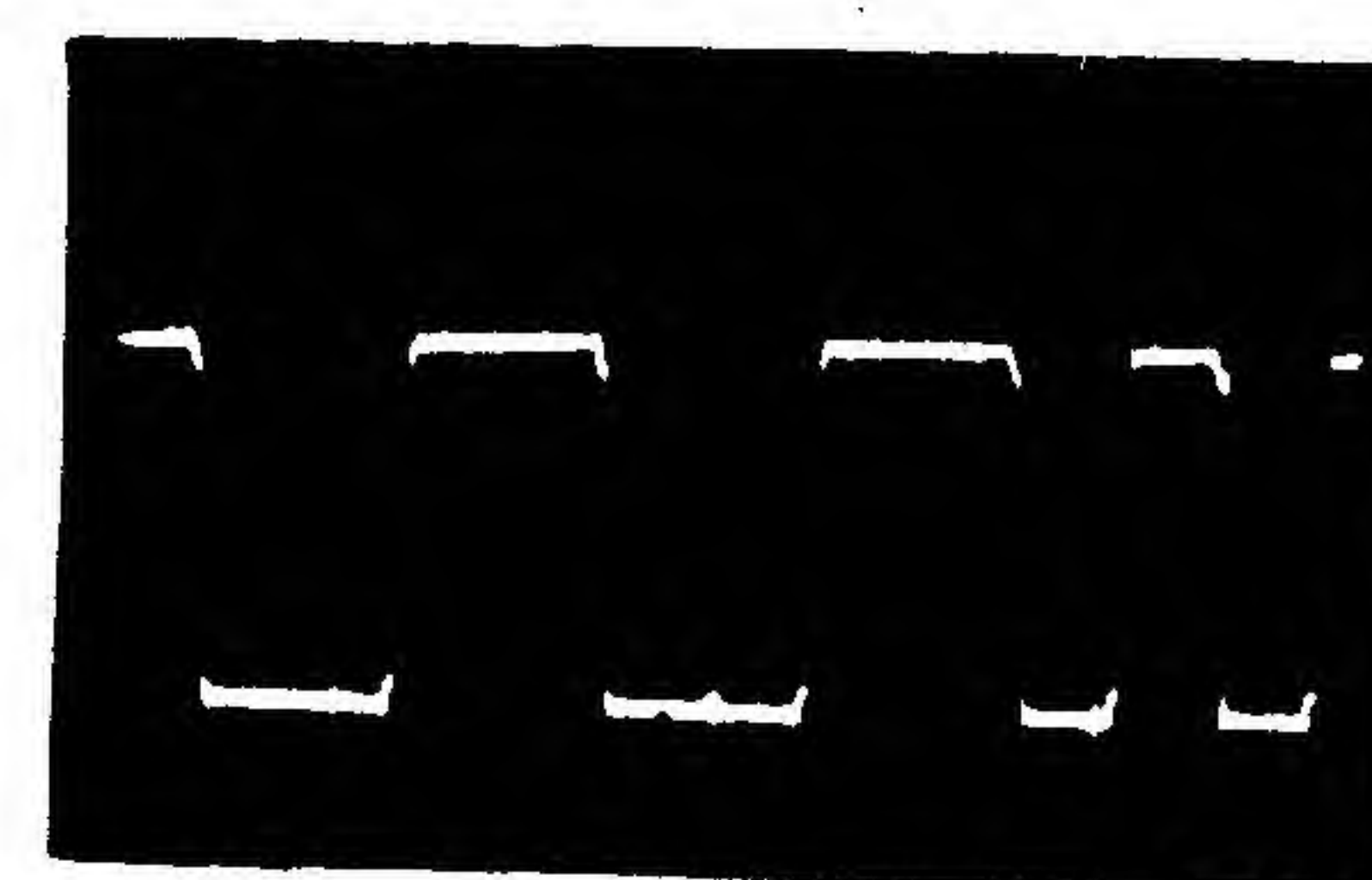


Block Diagram



CEF Input
(Pins A and B)

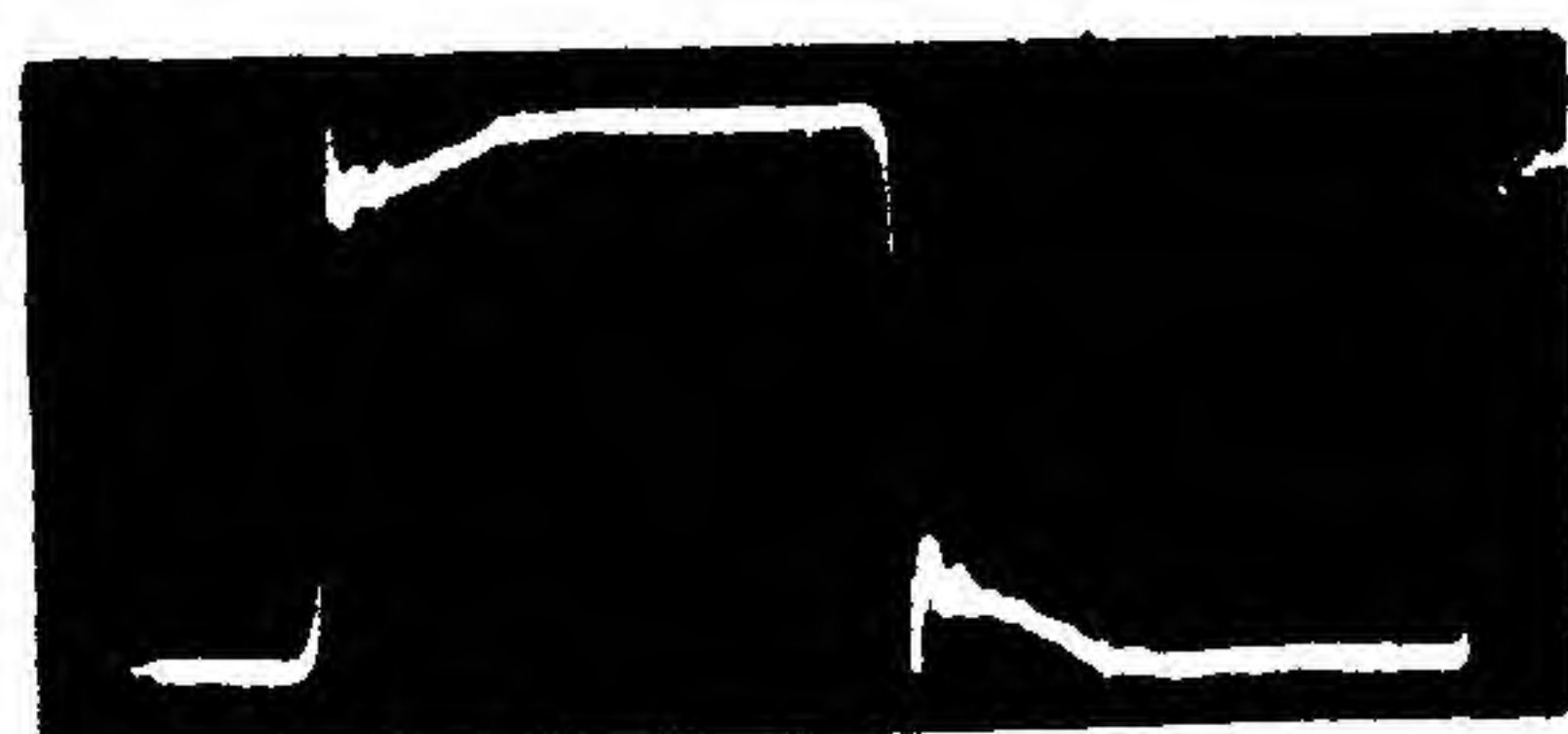
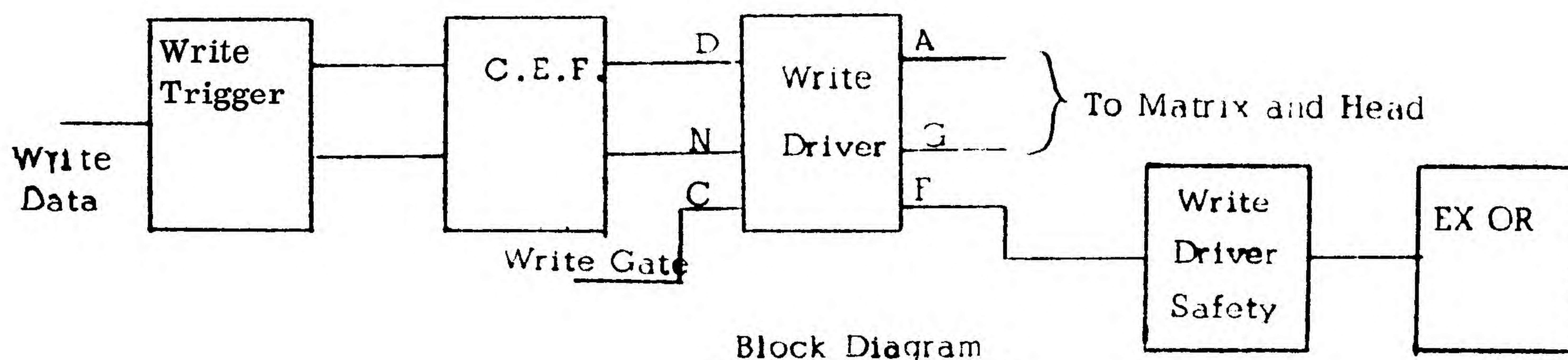
Sensitivity: 2 v/cm
Sweep: 0.5 μ sec./cm



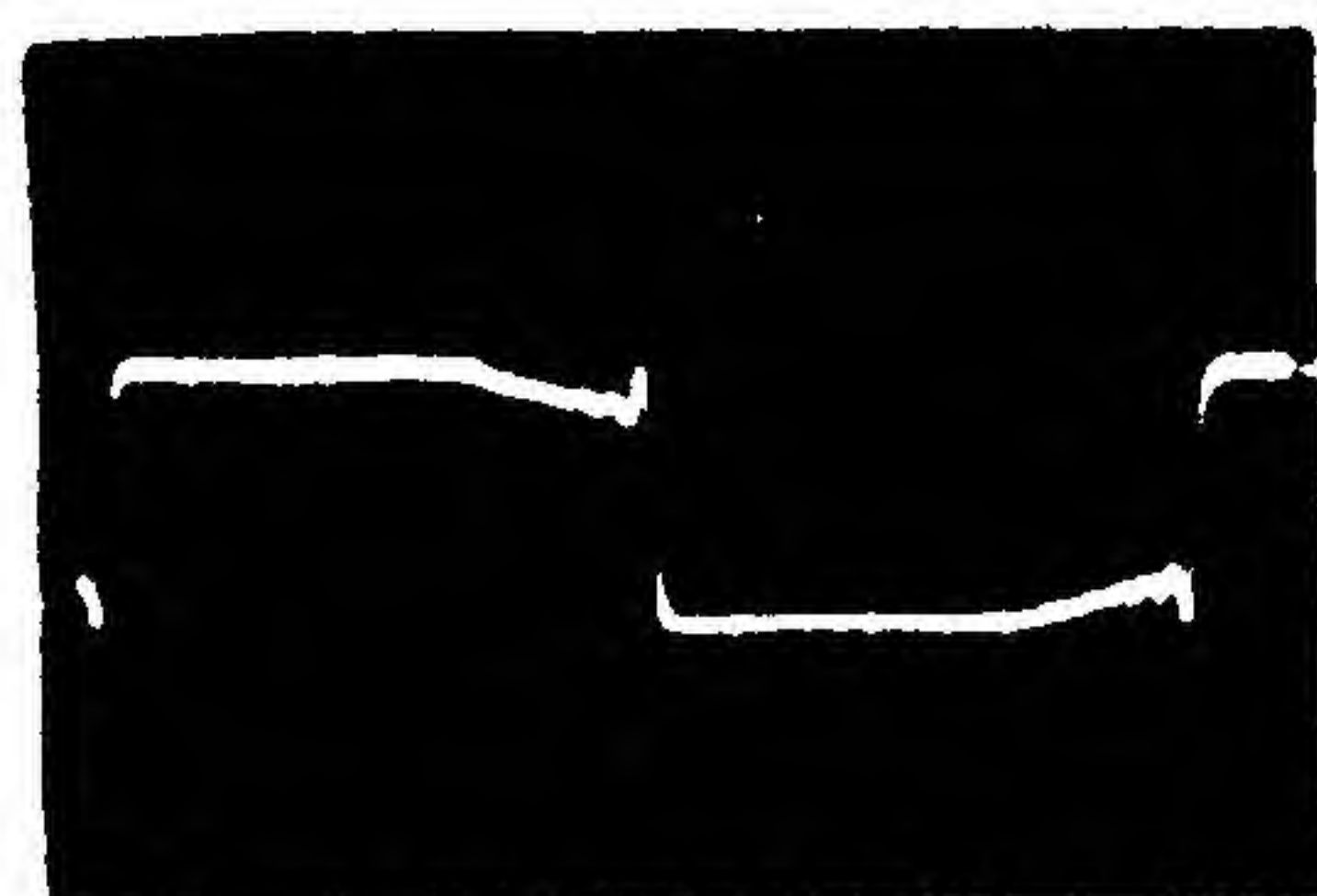
C.E.F. Output
(Pins D and C)

Sensitivity: 1 v/cm
Sweep: 0.5 μ sec./cm

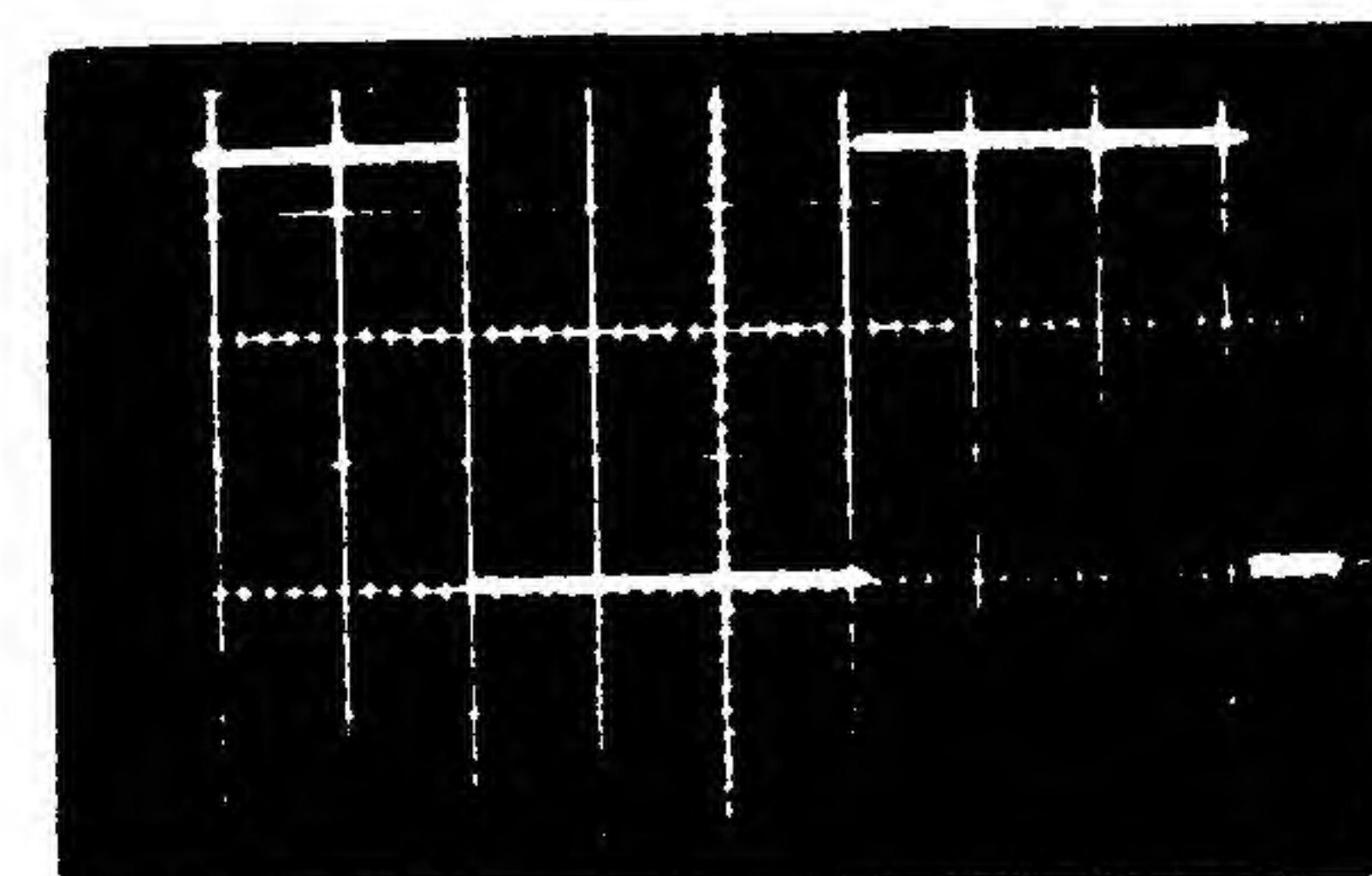
Figure 8-6 Complementary Emitter Follower Circuits



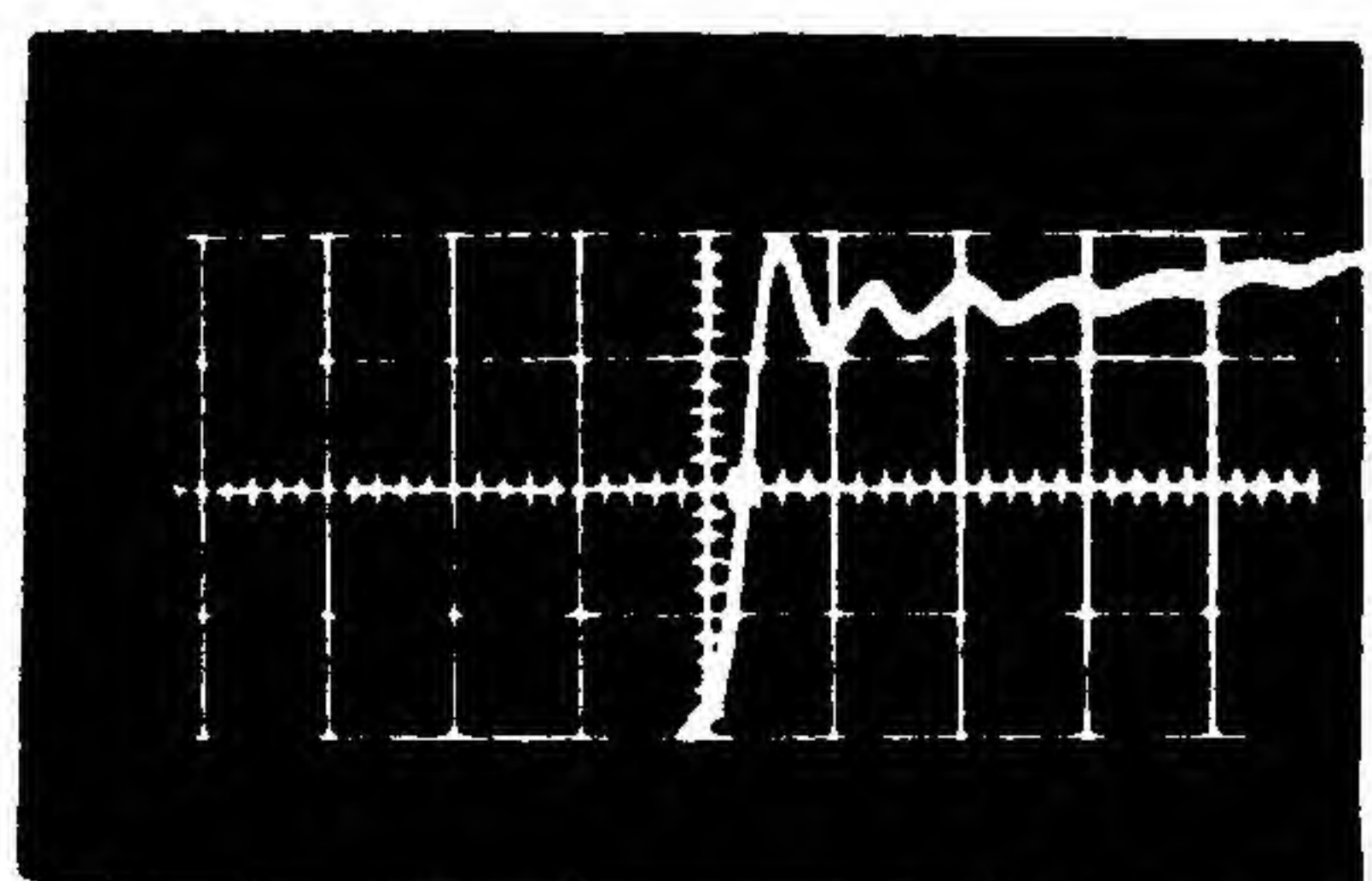
Write Current
(Pin A & G differential
Pin B connects to -36v)
Sensitivity: 50 ma/cm
Sweep: 200 ns/cm



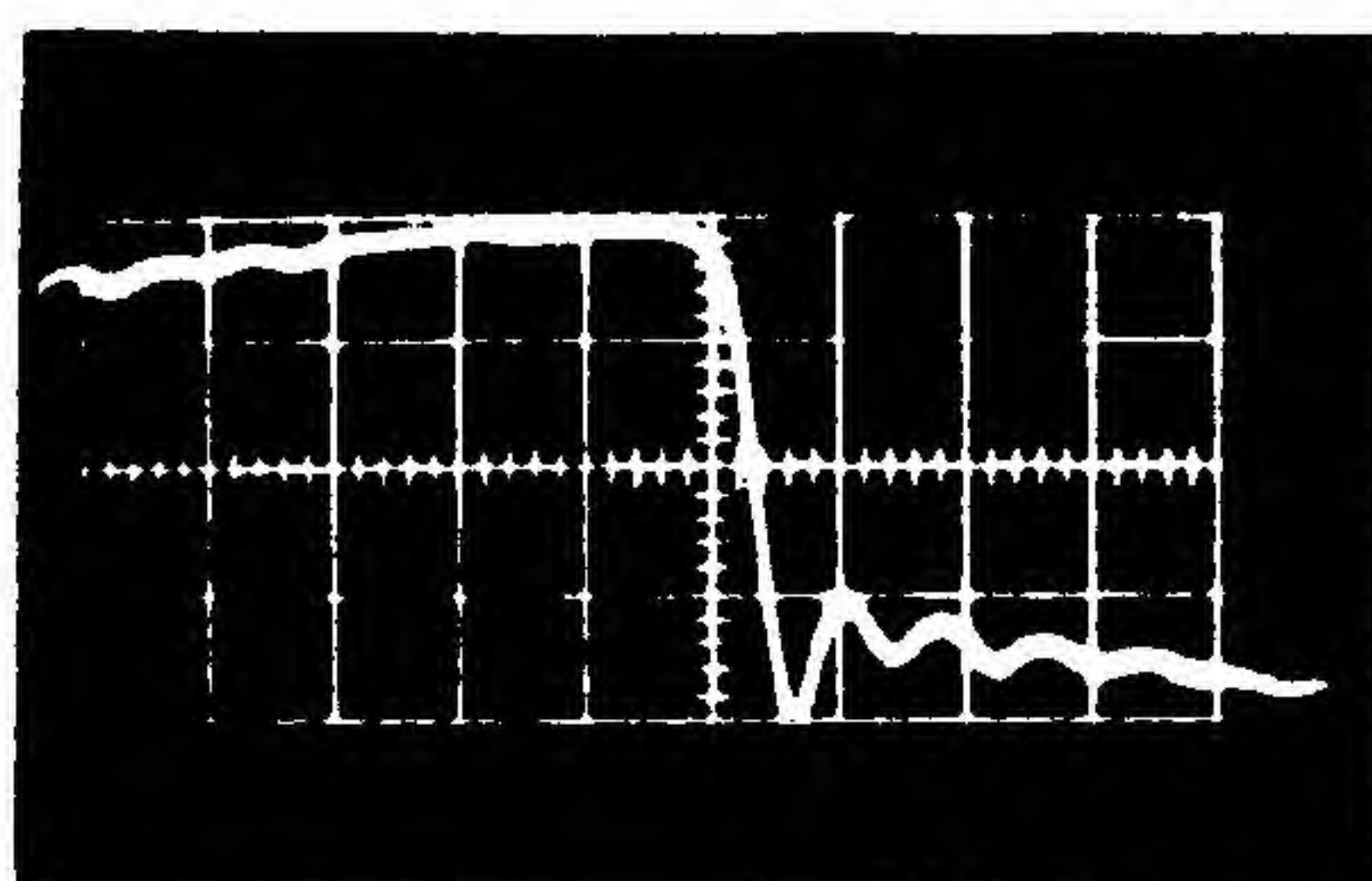
Write Current
(Pin A & G differential
Pin B open)
Sensitivity: 20 ma/cm
Sweep: 200 ns/cm



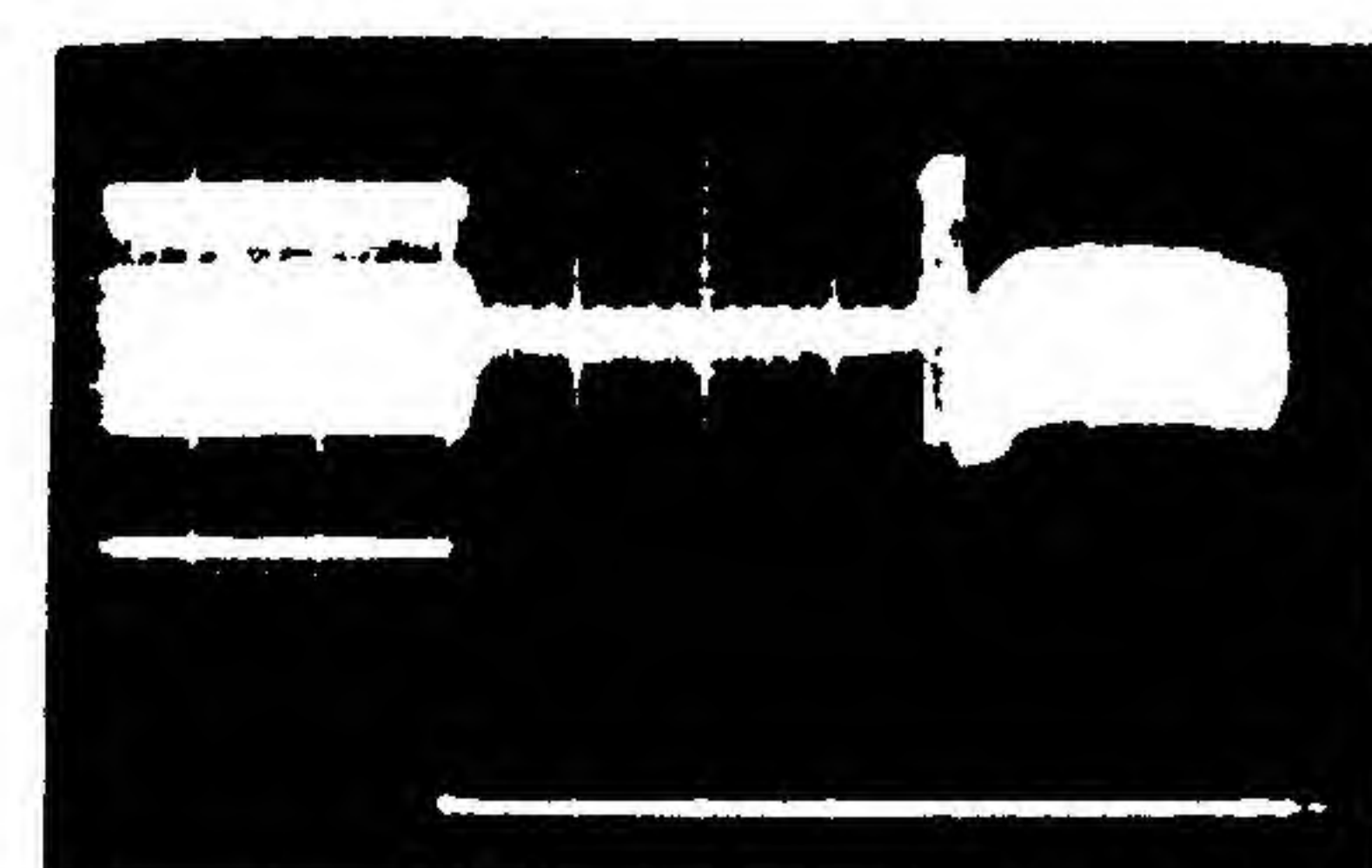
Voltage at Pin F
Sensitivity: 10 v/cm
Sweep: 10 MS/cm



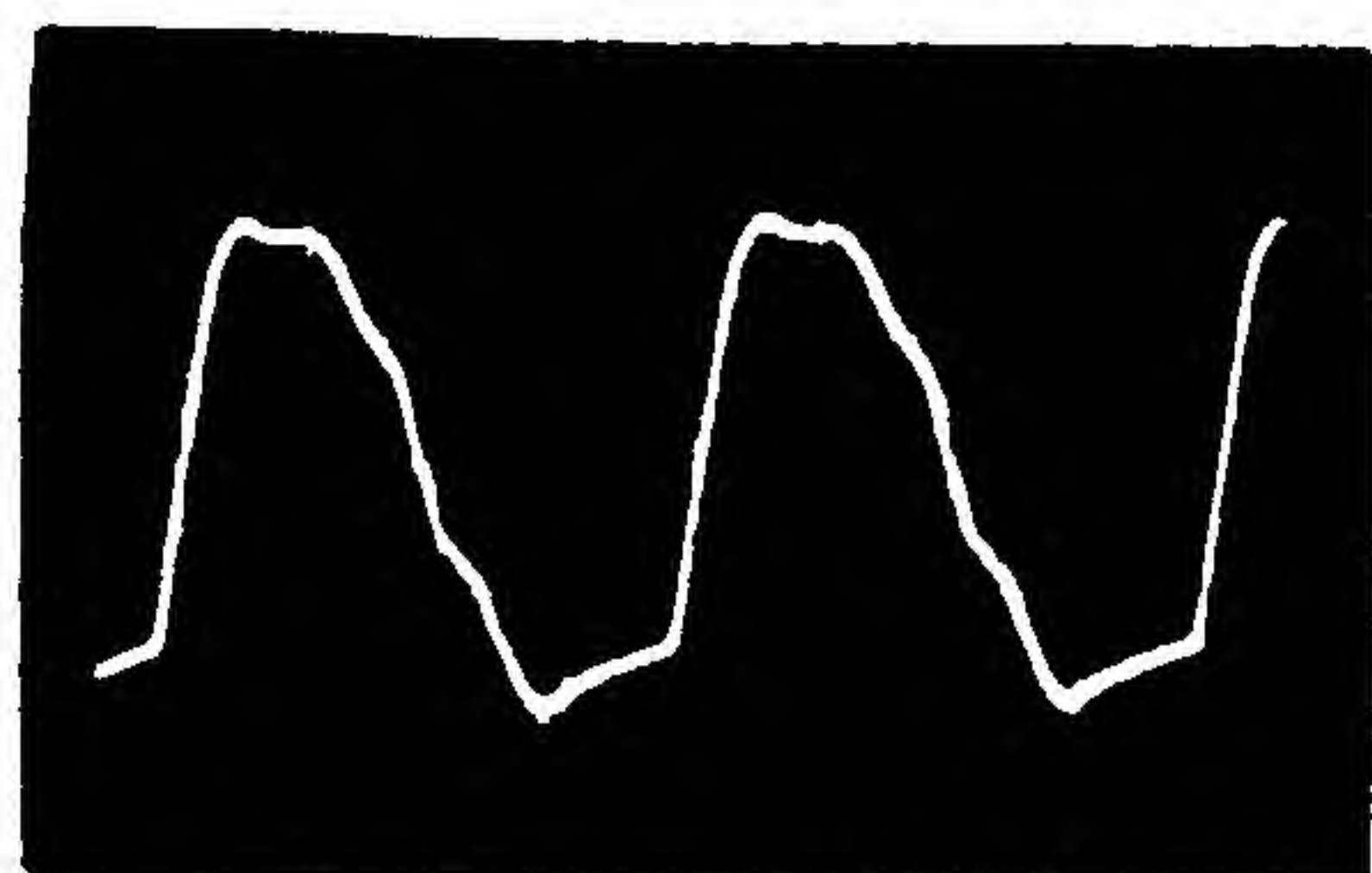
Current Rise Time
(Pin A & G differential
Pin B open)
Sensitivity: 20 ma/cm
Sweep: 50 ns/cm



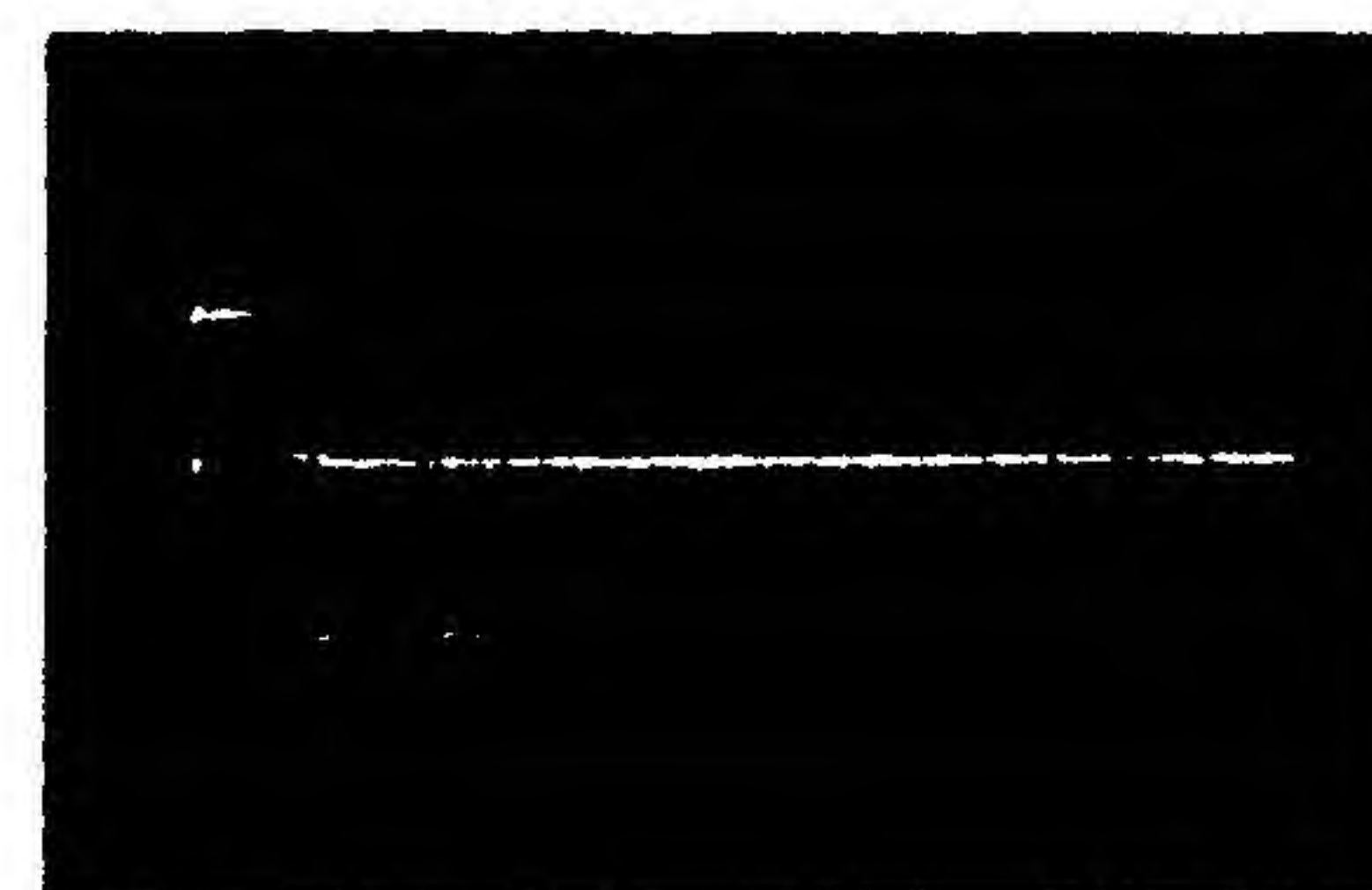
Current Fall Time
(Pin A & G differential
Pin B open)
Sensitivity: 20 ma/cm
Sweep: 50 ns/cm



Write to Read Recovery
A. Pre-amp Output
B. Write Gate
Sweep: 20 μ sec./cm



Write Driver Output
(Pin A or G)
Sensitivity: 10 v/cm
Sweep: 200 ns/cm



Turn on Delay
(A) Write Gate (PINC) Sensitivity: 5 v/cm
(B) Write Current Pin A & G Sensitivity: 50 ma/cm
Sweep: (synchronized) 1 μ sec./cm

Figure 8-7 Write Driver Circuits

18 db/octave after that. The emitter follower's stage isolates the filter from the differentiator whose impedance is frequency dependent. The differentiation of the read signal is performed by the last stage which has a gain of 2 at 1f and a gain of 4 at 2f. The differentiated signal is ac coupled to the output at Pins B and H.

Linear Amplifier

The linear amplifier is a two stage direct coupled differential amplifier with an emitter follower as an output stage. This circuit amplifies the input signals with a flat frequency response of 100 KC to 2 MC. The gain of this amplifier is approximately 18.

Output signals from the differentiator are applied at Pins A and C of the first amplifier stage which has a gain of approximately 3. The gain of the second stage is approximately 6. The amplified signal is then applied to the emitter follower and from there ac coupled to the output Pins F and H.

Overdriven Amplifier

This circuit is a high gain differential amplifier which overdrives the head signal without introducing any appreciable time shift.

The input signal to the three stage differential amplifier is through Pins A and C. The biasing voltage for the first stage is a -15v zener supply from the linear amplifier and is applied through Pins A and C. Pin L is also connected to the -15v zener supply to get the proper bias for the third stage. Large coupling capacitors between stages provide long time constant and therefore keep the DC level constant when the signal is overdriven. The gain of these three stages is approximately 80. The minimum head signal which will cause the overdriven amplifier to give a constant output amplitude is approximately 1 mv at 2f frequency.

Detector

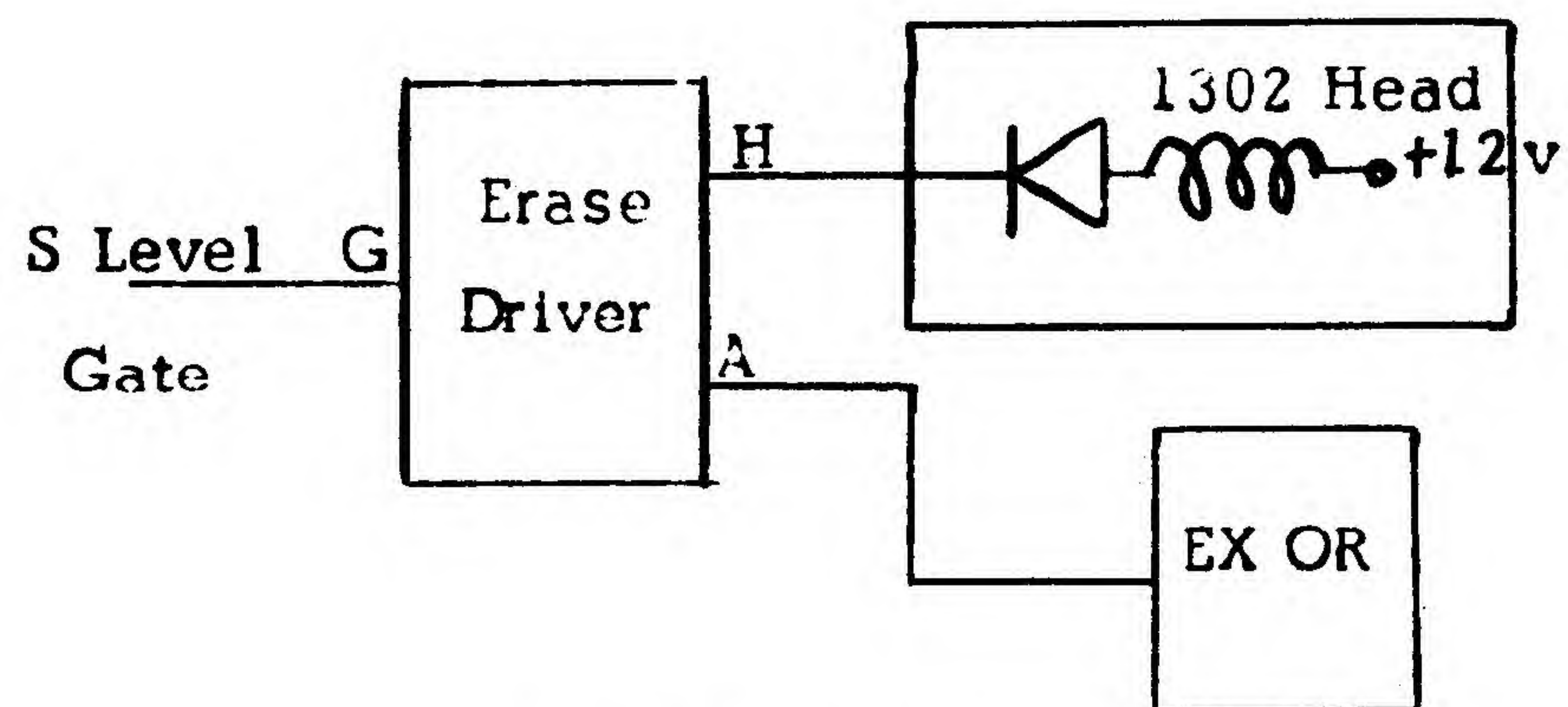
This circuit limits and differentiates the input signal. The generated pulse is then shaped and "ORed" at the output.

The output signal from the overdriven amplifier is fed into Pins A and C. A positive pulse at either pin is used to switch the current alternately between the two input transistors in the first stage. The limited signal from the first stage is then fed into the second stage where each transition is differentiated. The generated positive pulses are clipped to ground. The negative voltage pulse generated then turns on the transistor on the output stage for the duration of the pulse. The output at Pin E represents the raw data. The leading edge of each pulse corresponds to a peak in the head signal. The output is a standard +Y level.

Line Driver

The line driver provides drive power for a 93-ohm coaxial cable.

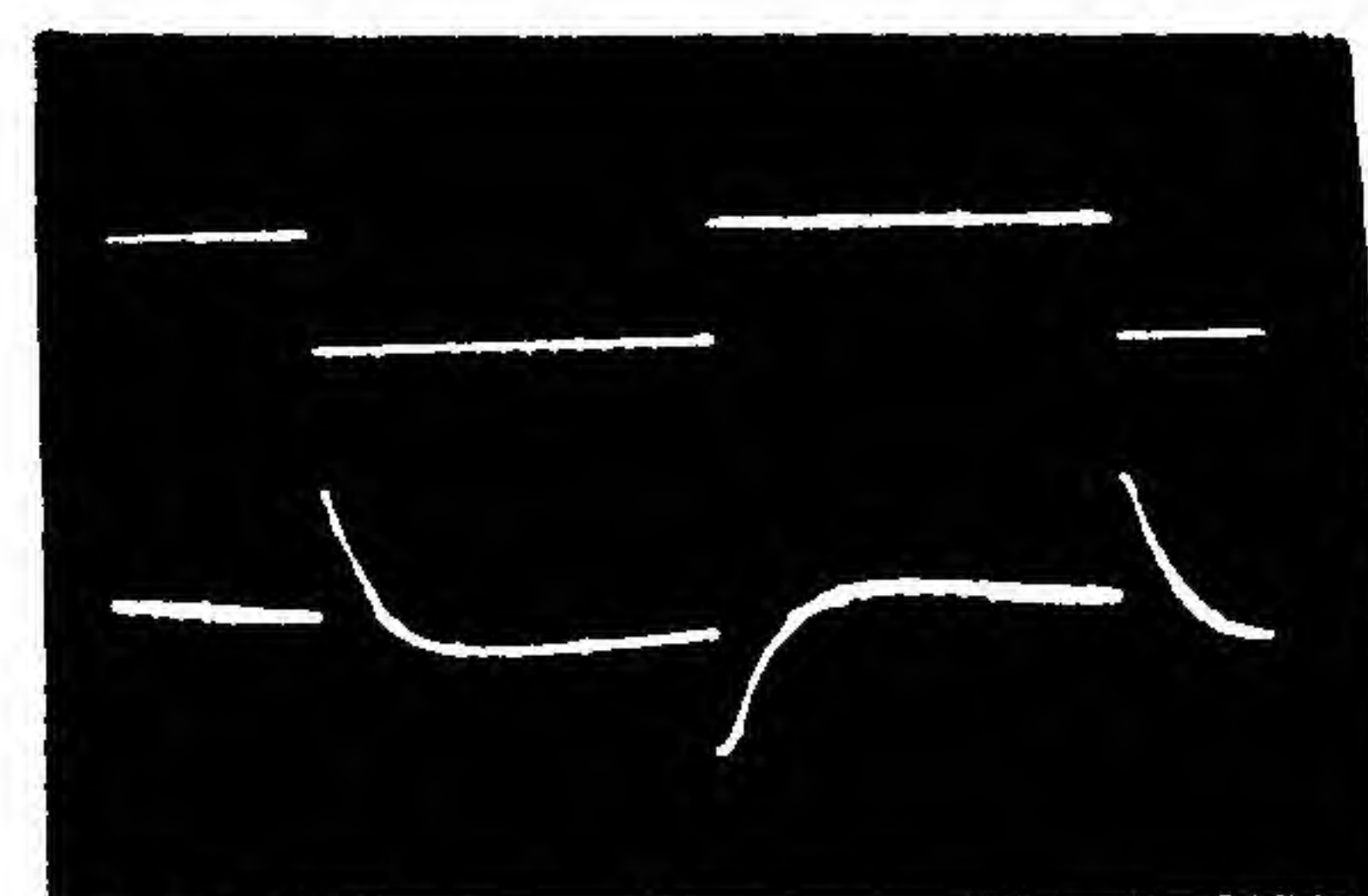
The input to Pin A of the line driver is a standard Y level. The output at Pin B is connected to a 93-ohm transmission line. A current of 10 ma is available at Pin B to drive the coaxial cable when the input gate is at +Y level.



Block Diagram

(A)

(B)

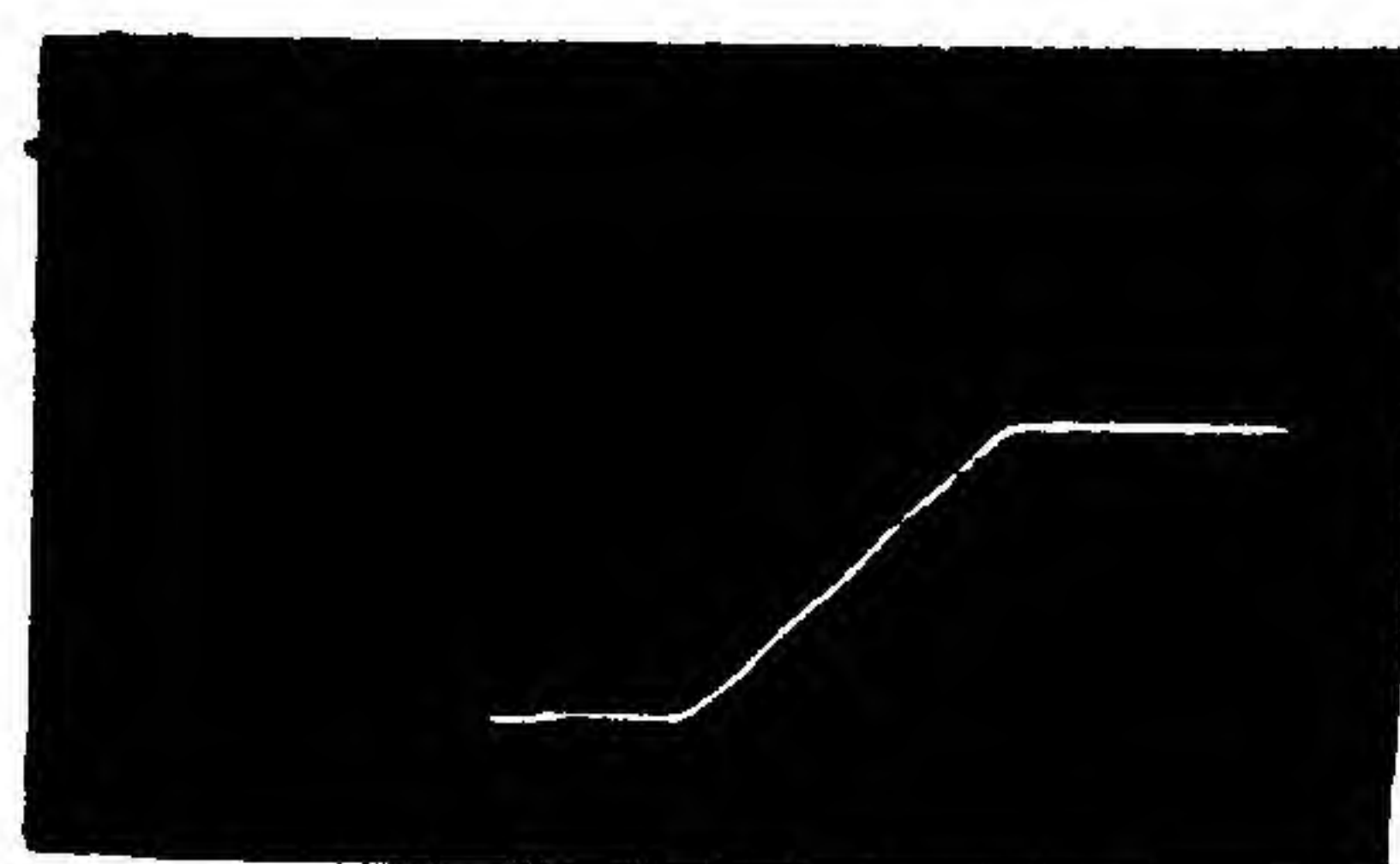


(A) Input Gate (Pin G)

Sensitivity: 5 v/cm
Sweep: 10 μ sec./cm

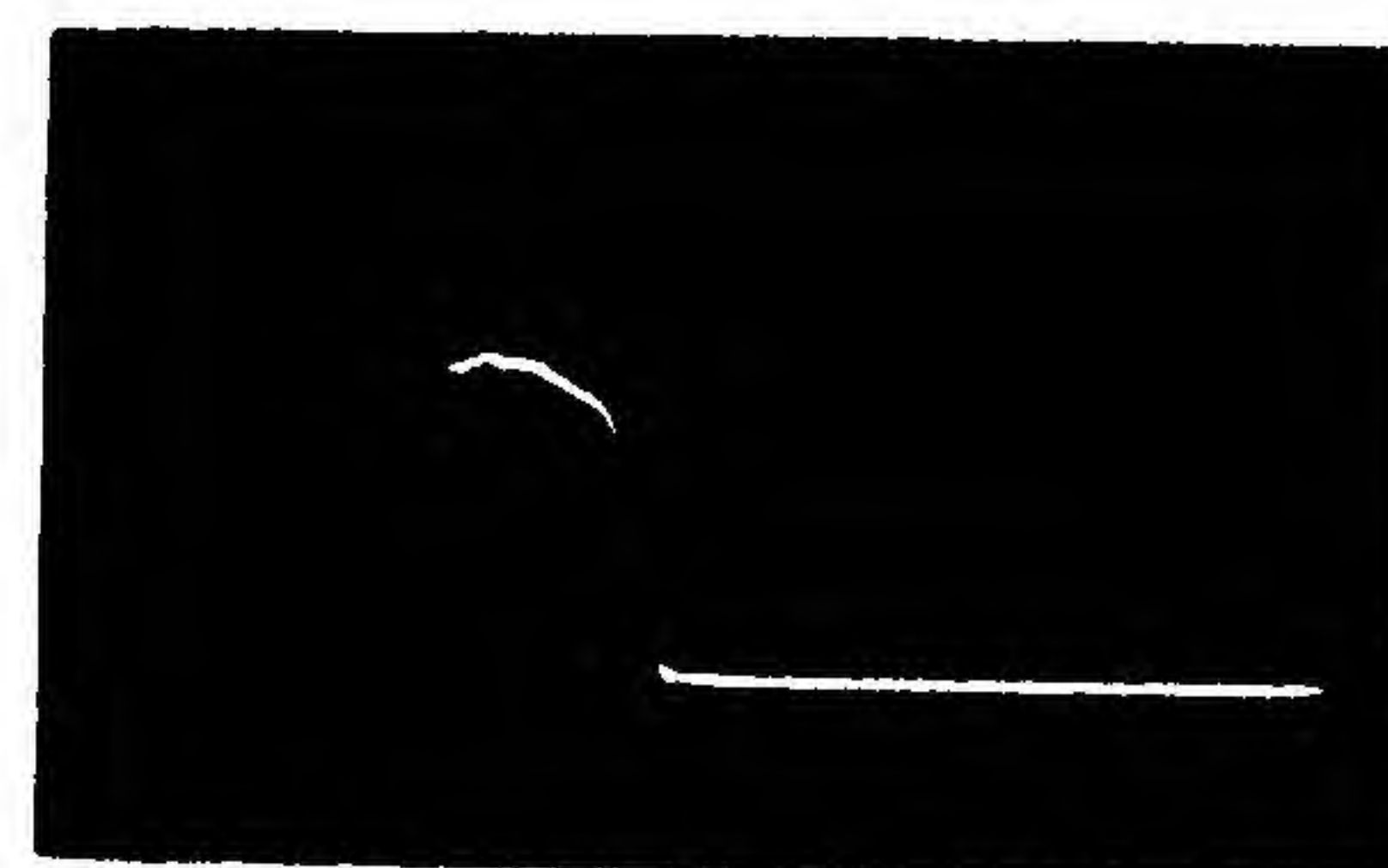
(B) Erase Current (Pin H)

Sensitivity: 50 ma/cm
Sweep: 10 μ sec./cm



(A) Rise Time

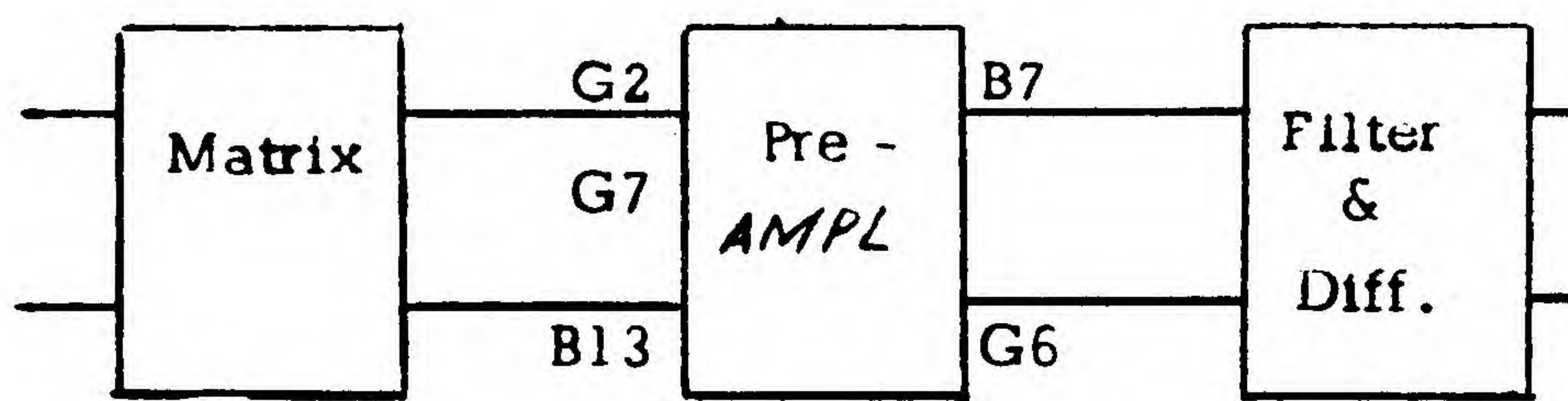
Sensitivity: 20 ma/cm
Sweep: 2 μ sec./cm



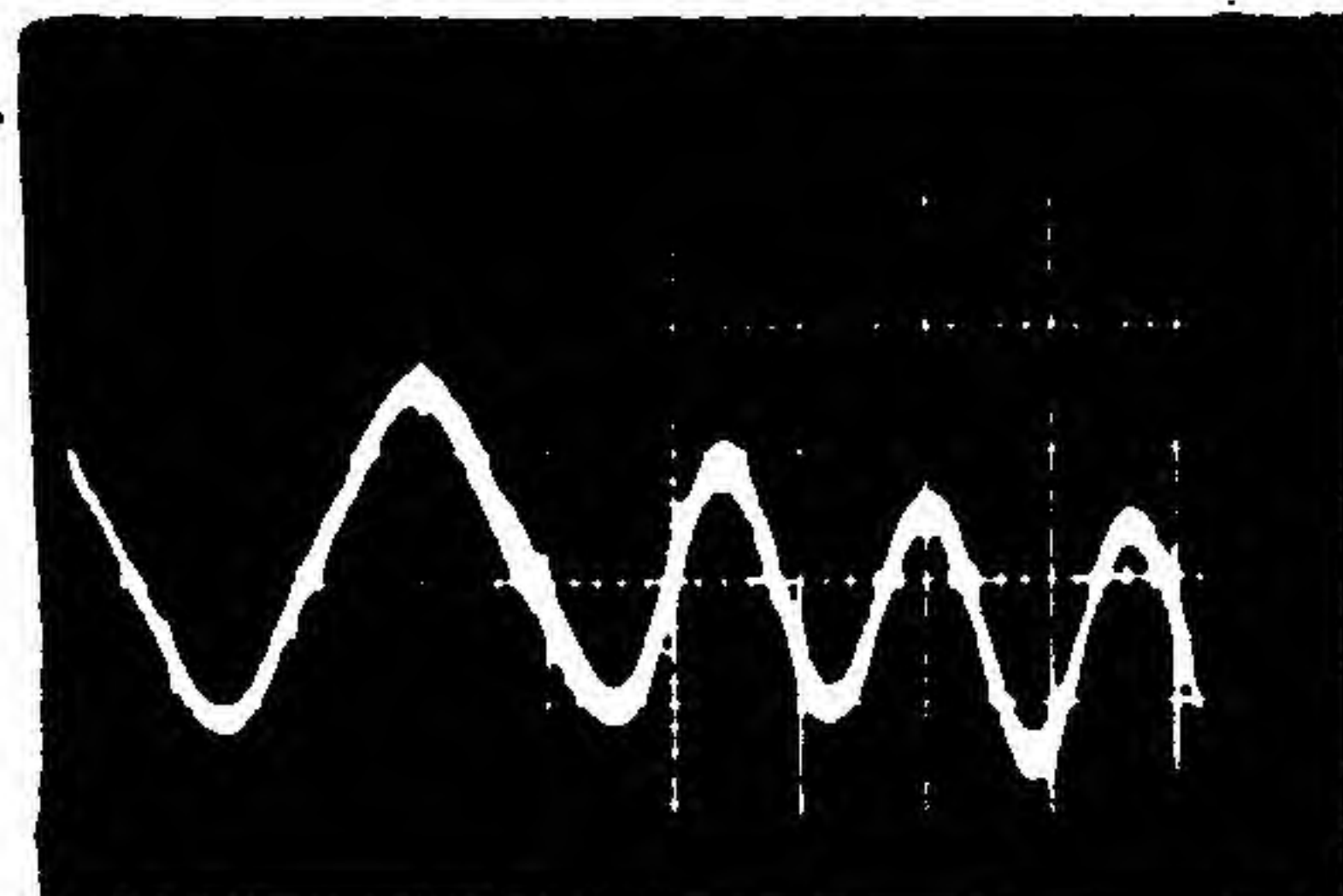
(B) Fall Time

Sensitivity: 20 ma/cm
Sweep: 2 μ sec./cm

Figure 8-8 Erase Driver Circuits

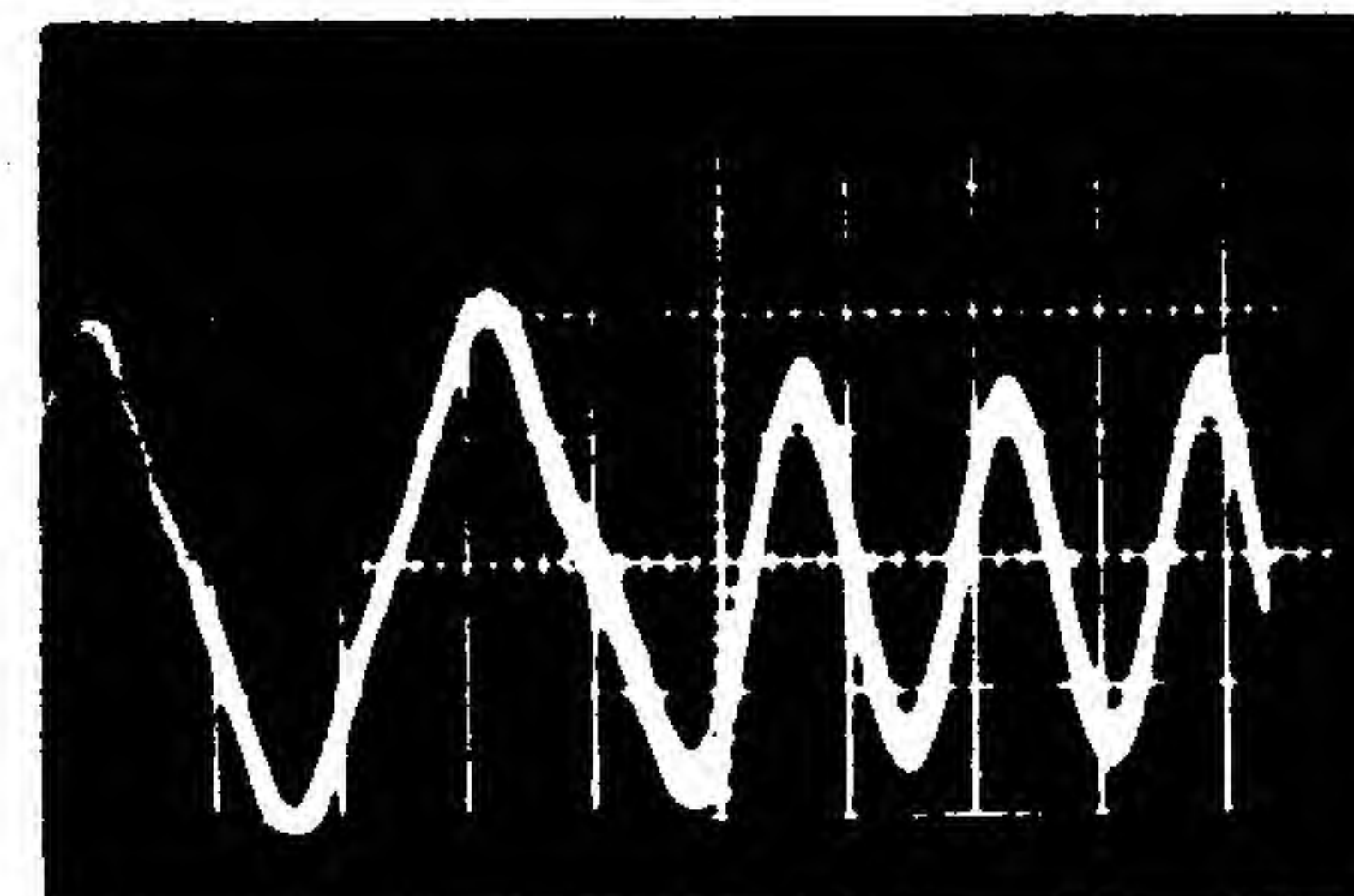


Block Diagram



Input Voltage Wave Form
(Pins G2 & B13)

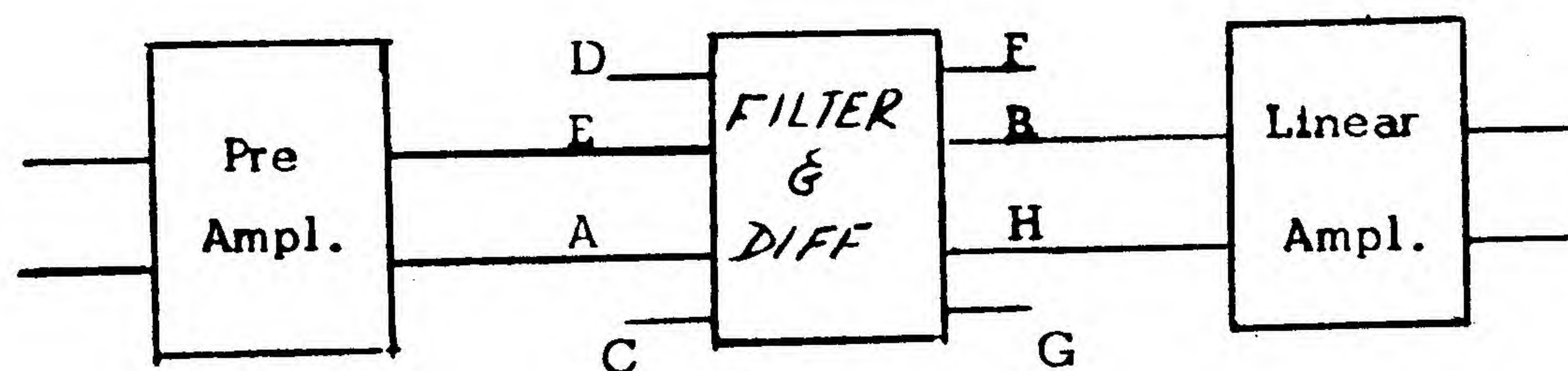
Sensitivity: 5 mv/cm
Sweep: 0.5 μ sec./cm



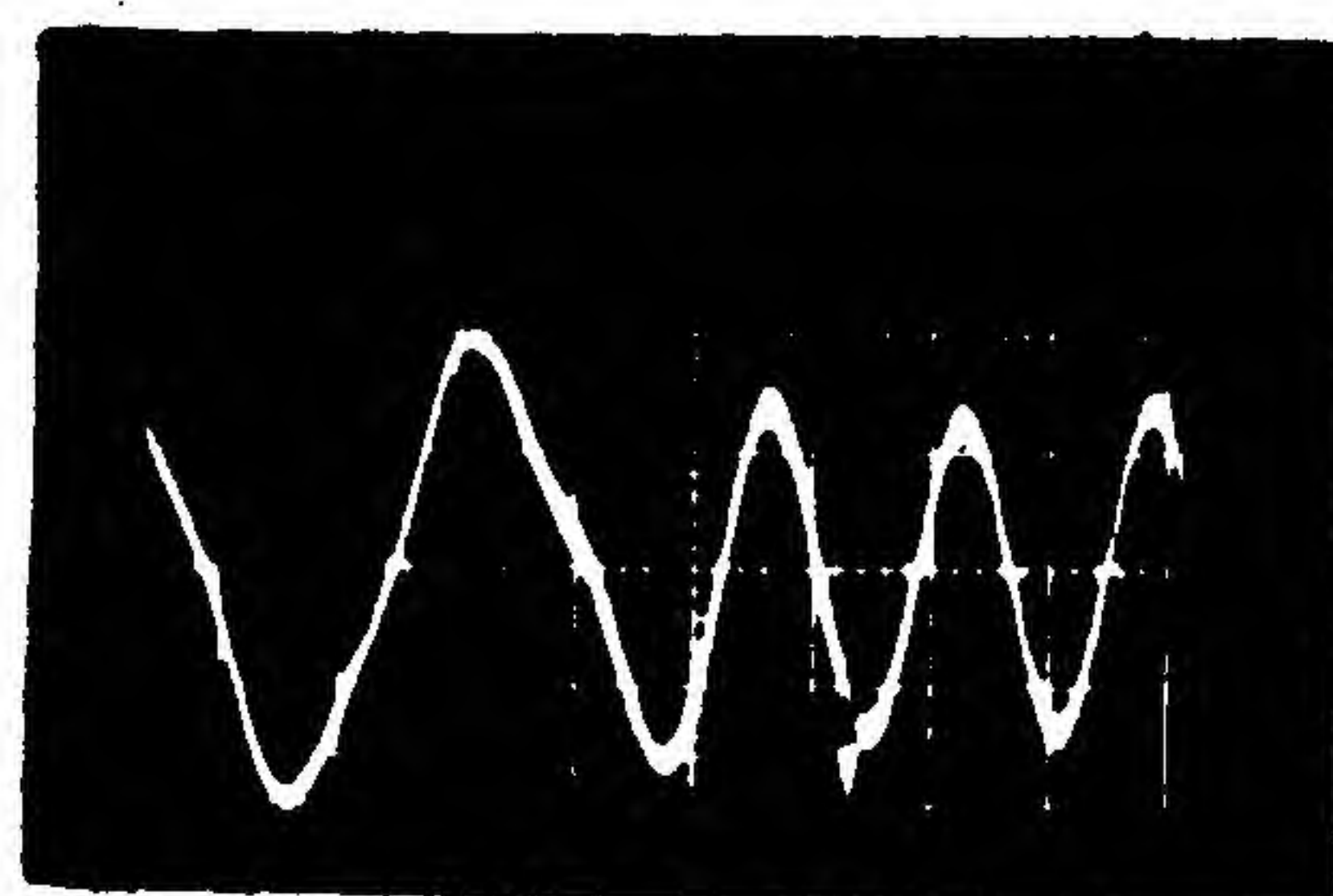
Output Voltage Wave Form
(Pins B7 & G6)

Sensitivity: 10 mv/cm
Sweep: 0.5 μ sec./cm

Figure 8-9 Preamplifier Circuits

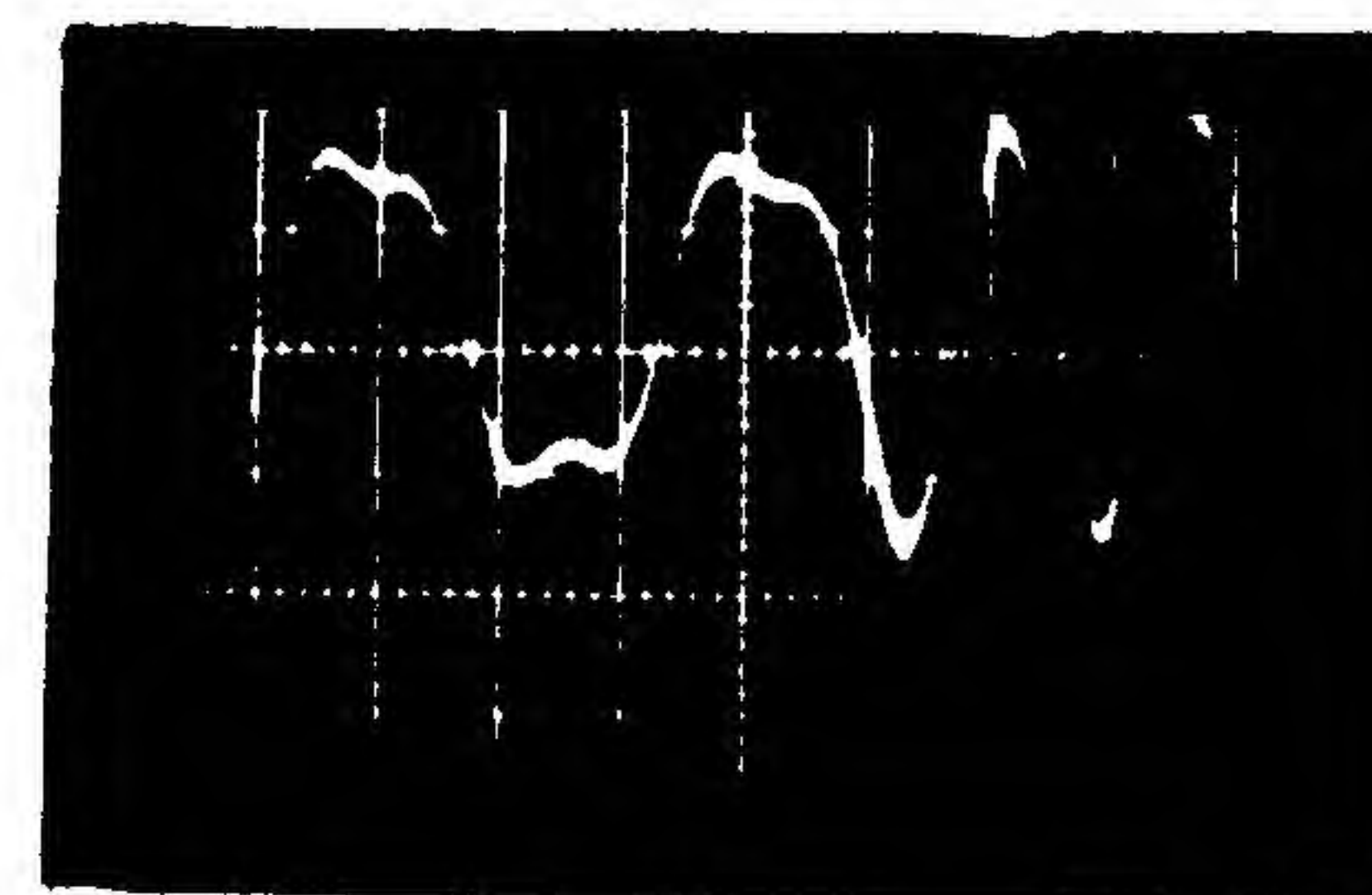


Block Diagram



Filter Output
(Pins F & G)

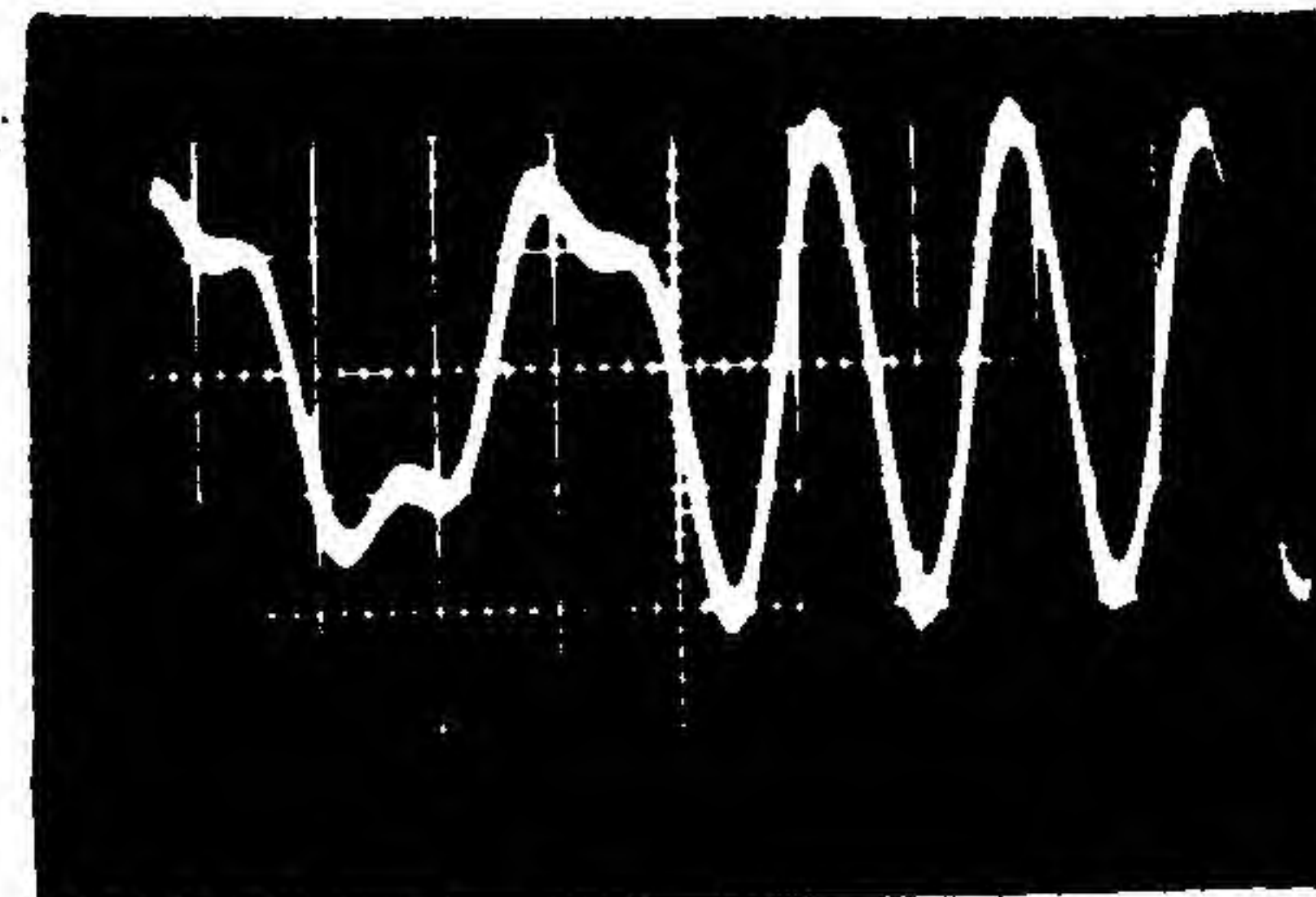
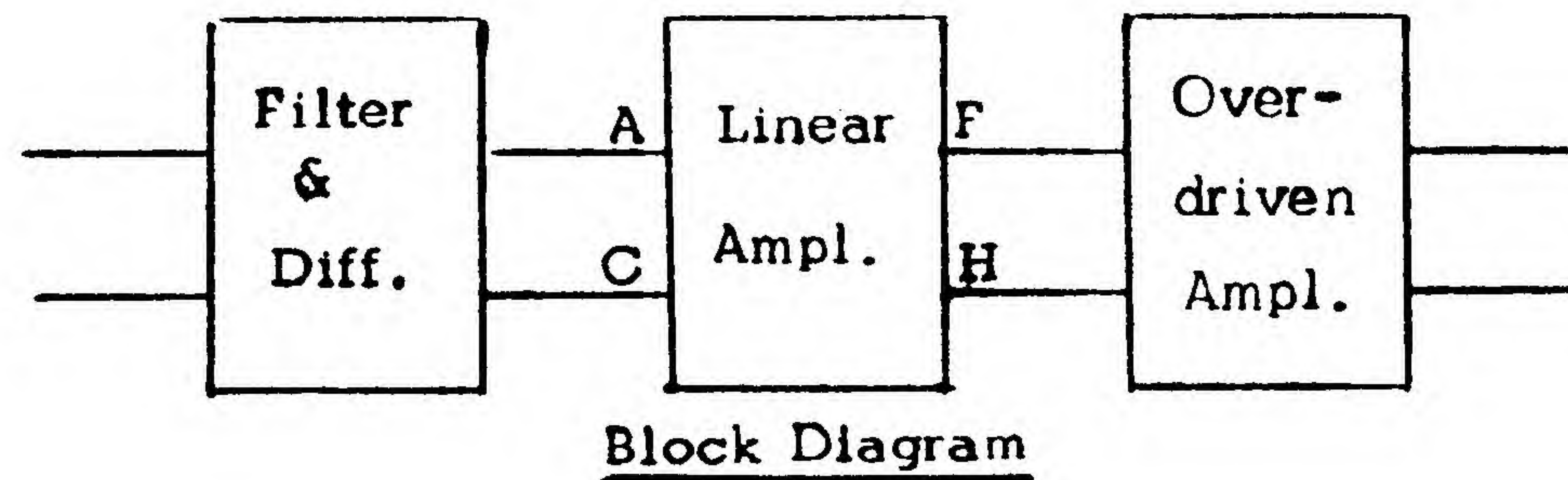
Sensitivity: 50 mv/cm
Sweep: 0.5 μ sec./cm



Differentiator Output
(Pins B & H)

Sensitivity: 100 mv/cm
Sweep: 0.5 μ sec./cm

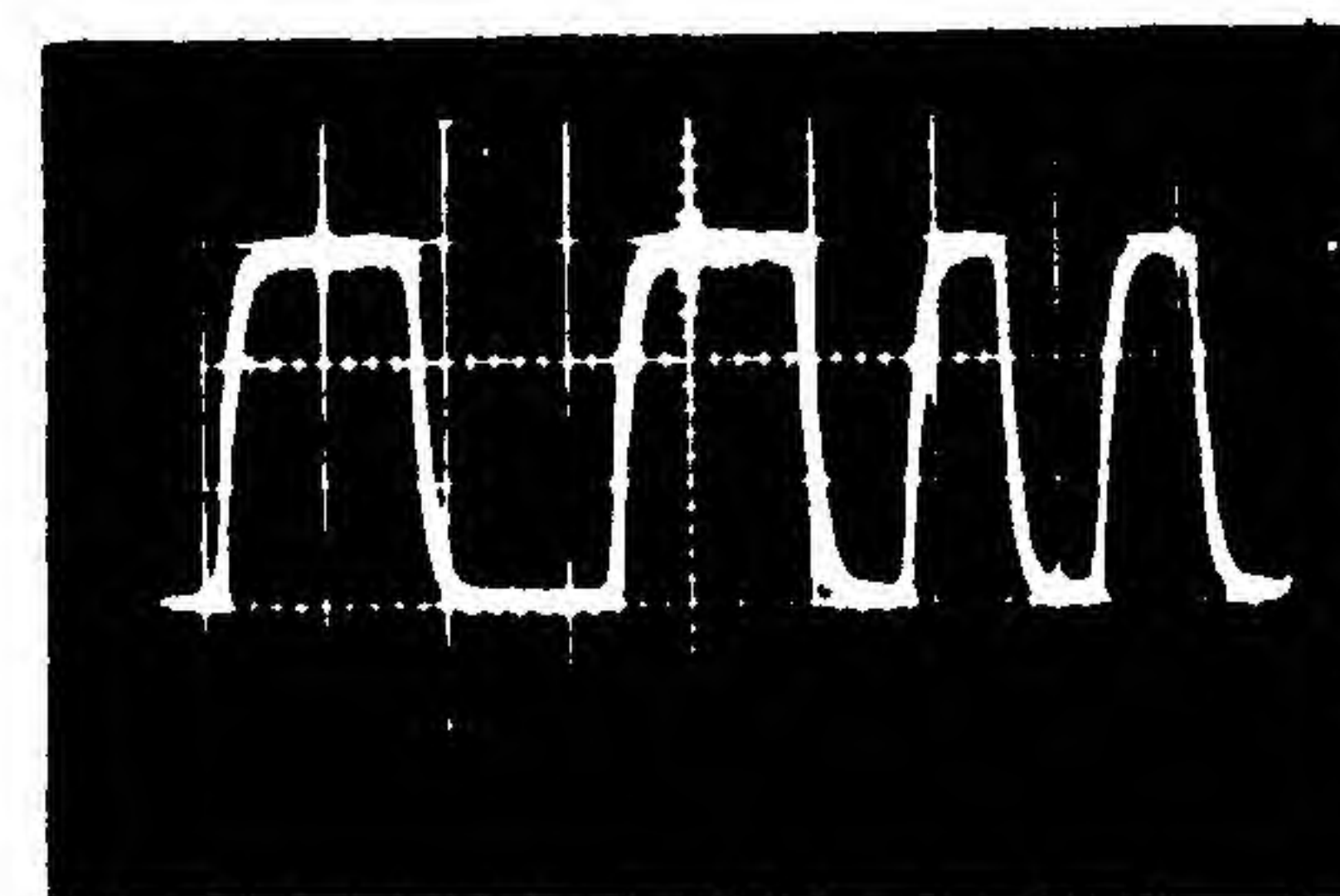
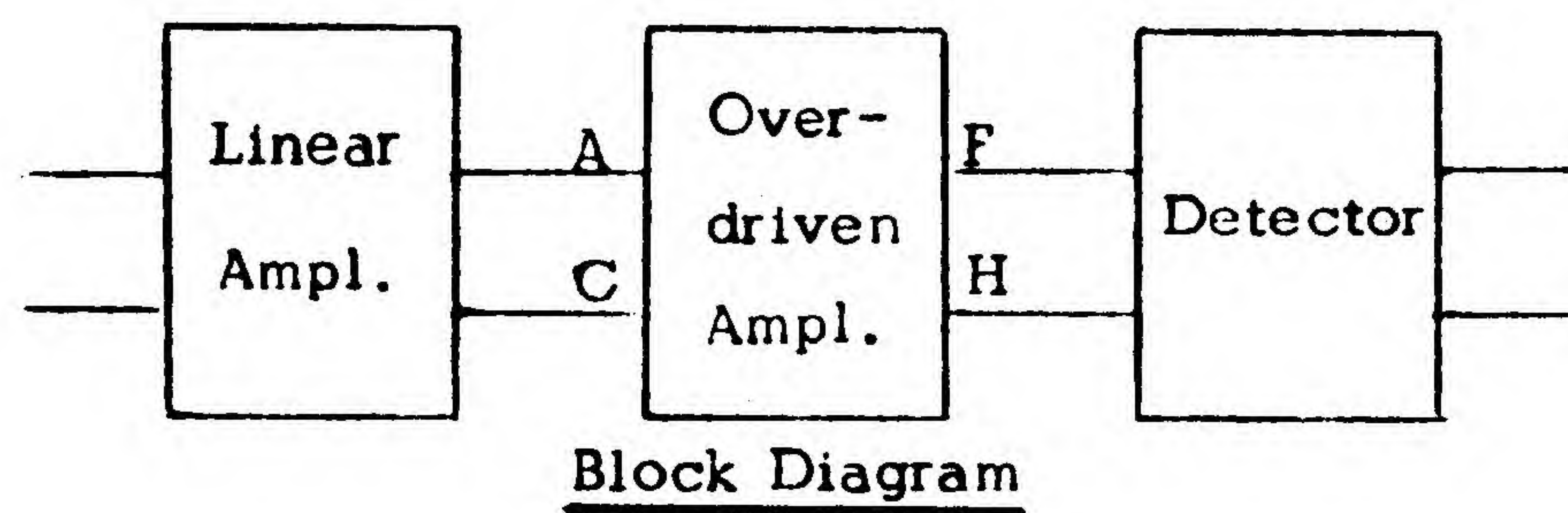
Figure 8-10 Filter Differentiator Circuits



Linear Amplifier Output
(Pins F & H)

Sensitivity: 2 v/cm
Sweep: 0.5 μ sec./cm

Figure 8-11 Linear Amplifier Circuits



Overdriven Amplifier Output
(Pins F & H)

Sensitivity: 10 v /cm
Sweep: 0.5 μ sec./cm

Figure 8-12 Overdriven Amplifier Circuits

Line Terminator

The line terminator provides a load for the line driver and supplies an in phase Y line output respective to the line driver input.

Pin A is a direct connection through the transmission line to the collector of the output transistor of the line driver. When the output transistor of the line driver is "on," current flows through the transmission line to the input of the line terminator; the output at Pin B will be at 0 volts. If the output transistor of the line driver is "off," no current flows in the transmission line. Subsequently, the output at Pin B of the line terminator is clamped to -6 volts.

Selection Matrix

The selection matrix provides gating for the read-write head during a read or a write operatin.

During a write cycle, "X-select" Pin B 10 is at -30v, thus back biasing the diodes connecting to the read amplifiers. There is write current from the write driver into Pins B4 and B12 and out at Pins B7 and B9 to the read-write coil of the head. During a read cycle, "X-select" is at 1 -2v, forward biasing the diodes connecting to the read amplifiers and the read-write coil of the head; and no current is available from the write driver.

Selection Safety

The selection safety circuit prevents the loss of recorded information if the -12v or +12v supplies should fail. It also provides +12 volts through "Y-select" to the read-write coil when writing and 0 volts when reading.

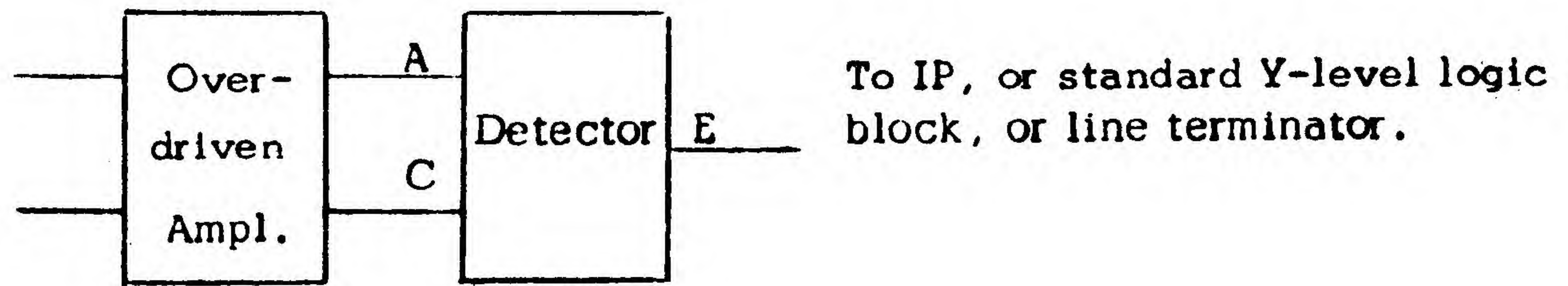
The input to Pin E is driven by an unloaded Y level logic. An up level (0v) at Pin E brings forth +12 volts at Pin F to the "Y-select." If the "Y-select" is properly gated, the -12 volts appears at the center tap of the read-write head. Likewise, a down level input at Pin E results in 0 at the head. Provisions have been made that if the -12v or +12v supplies should fail, no current is available at Pin F subsequently to the head.

Y-Select

The read/write Y-select circuit selects a Y line in the selection matrix and provides gate voltages to the selected head when in the read or write mode.

Pin H operates on an S level input. When Pin H is driven to a +S level, the output at Pin E is determined by the voltage level at Pin A which is the output of the selection safety card.

When the write mode is selected pin E is +12 volts, gating the write driver and erase driver to the ON condition. When the read mode is selected Pin E is 0 volt gating the write and erase drivers to the off condition but allowing the selected head to read. When the input to Pin H is at a -S level, Pin E is -36 volts which gates off the head in that particular Y line of the selection matrix.



Block Diagram

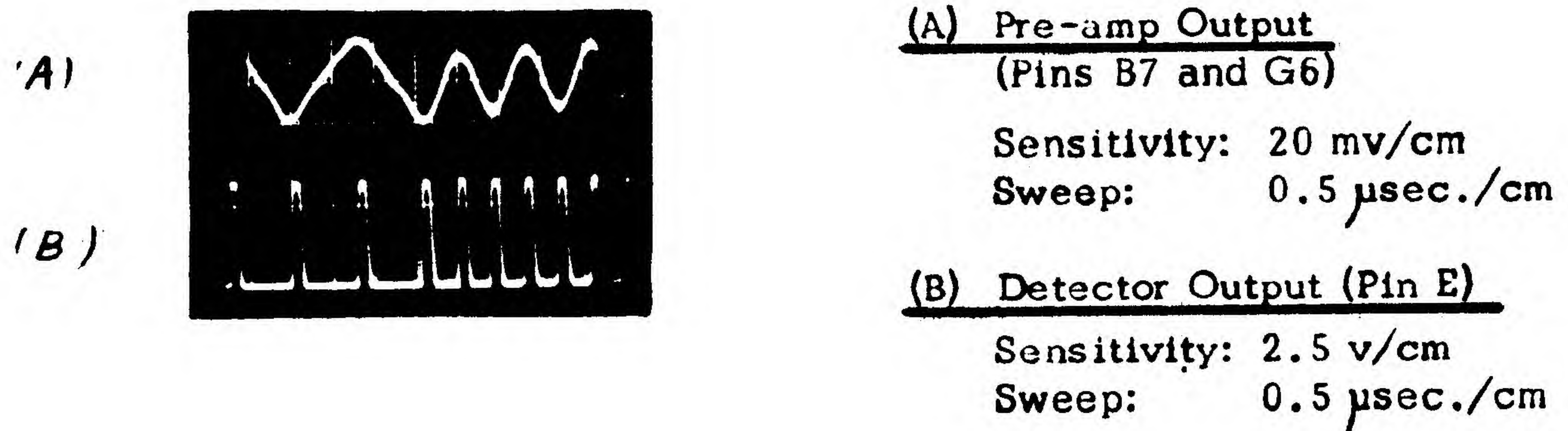
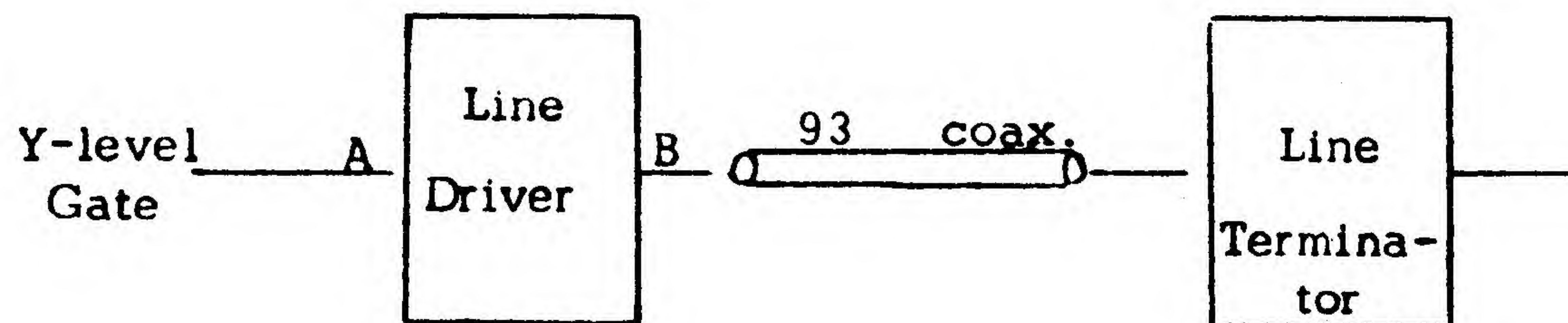
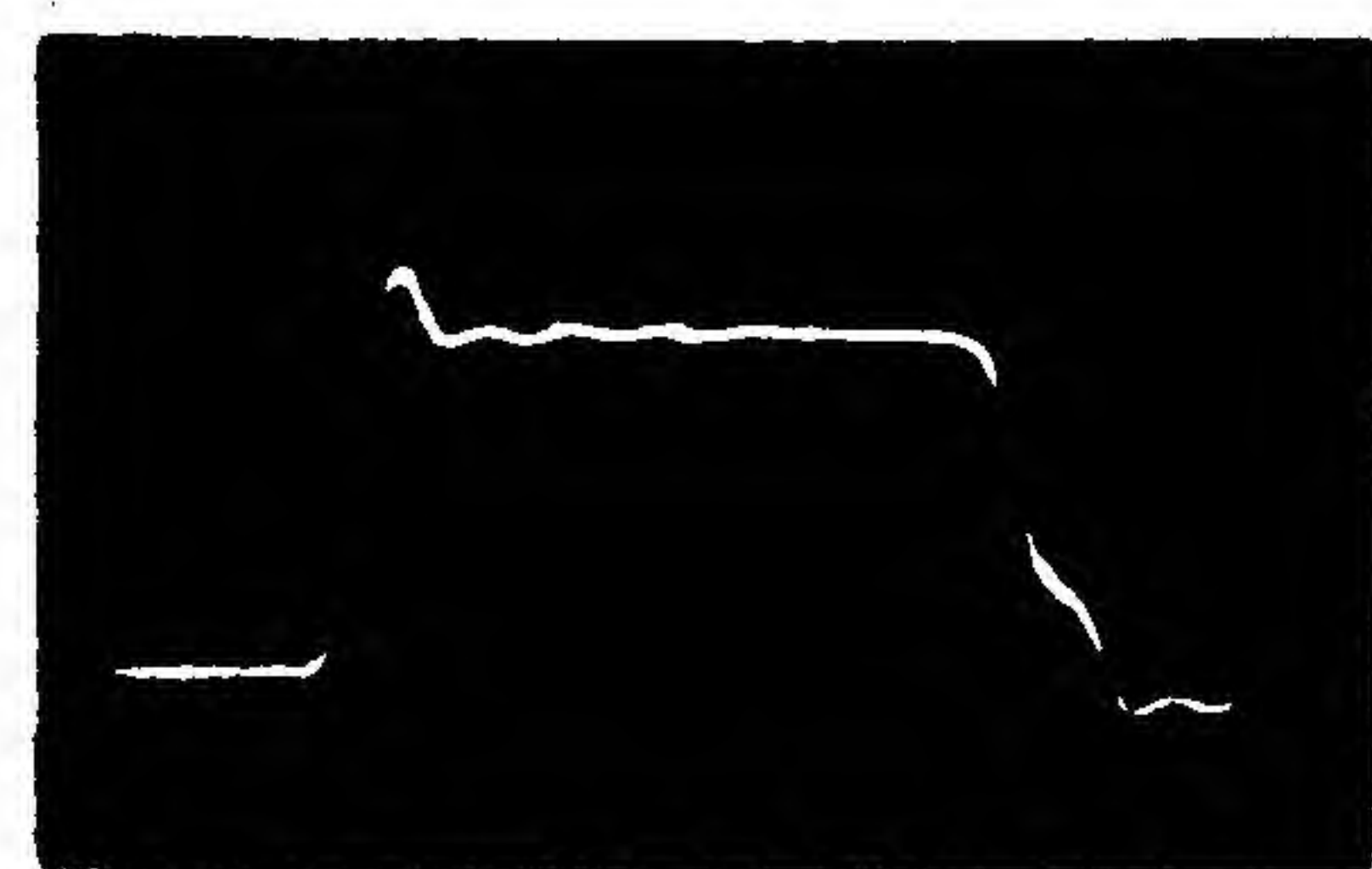


Figure 8-13 Detector Circuits

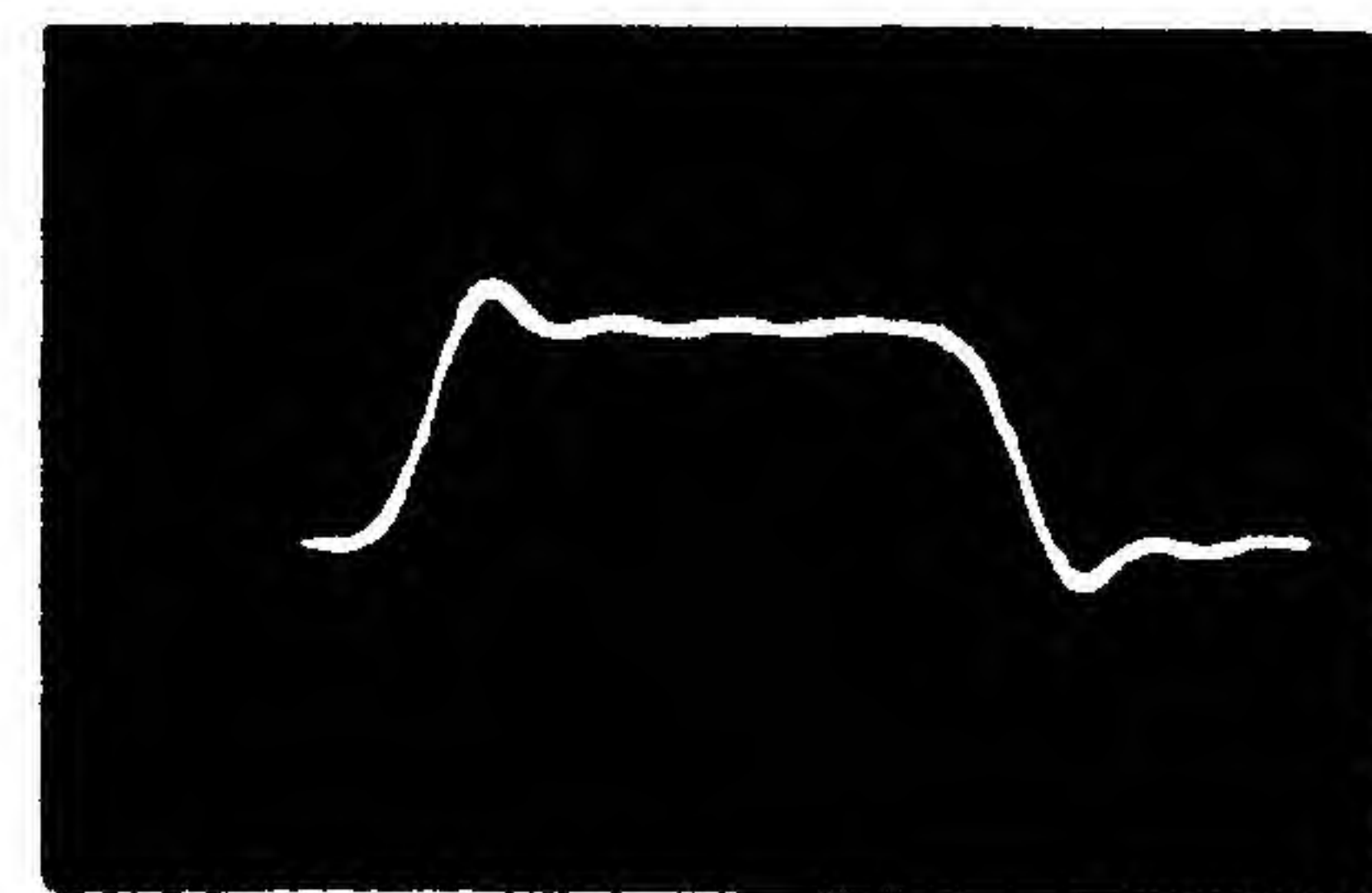


Block Diagram



Input to Line Driver
(Pin A)

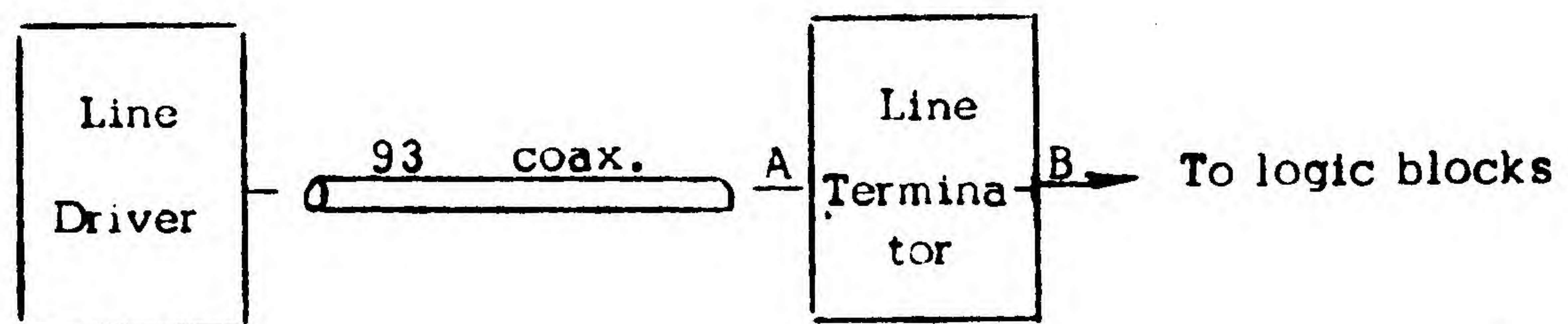
Sensitivity: 2 v/cm
Sweep: 20 ns/cm



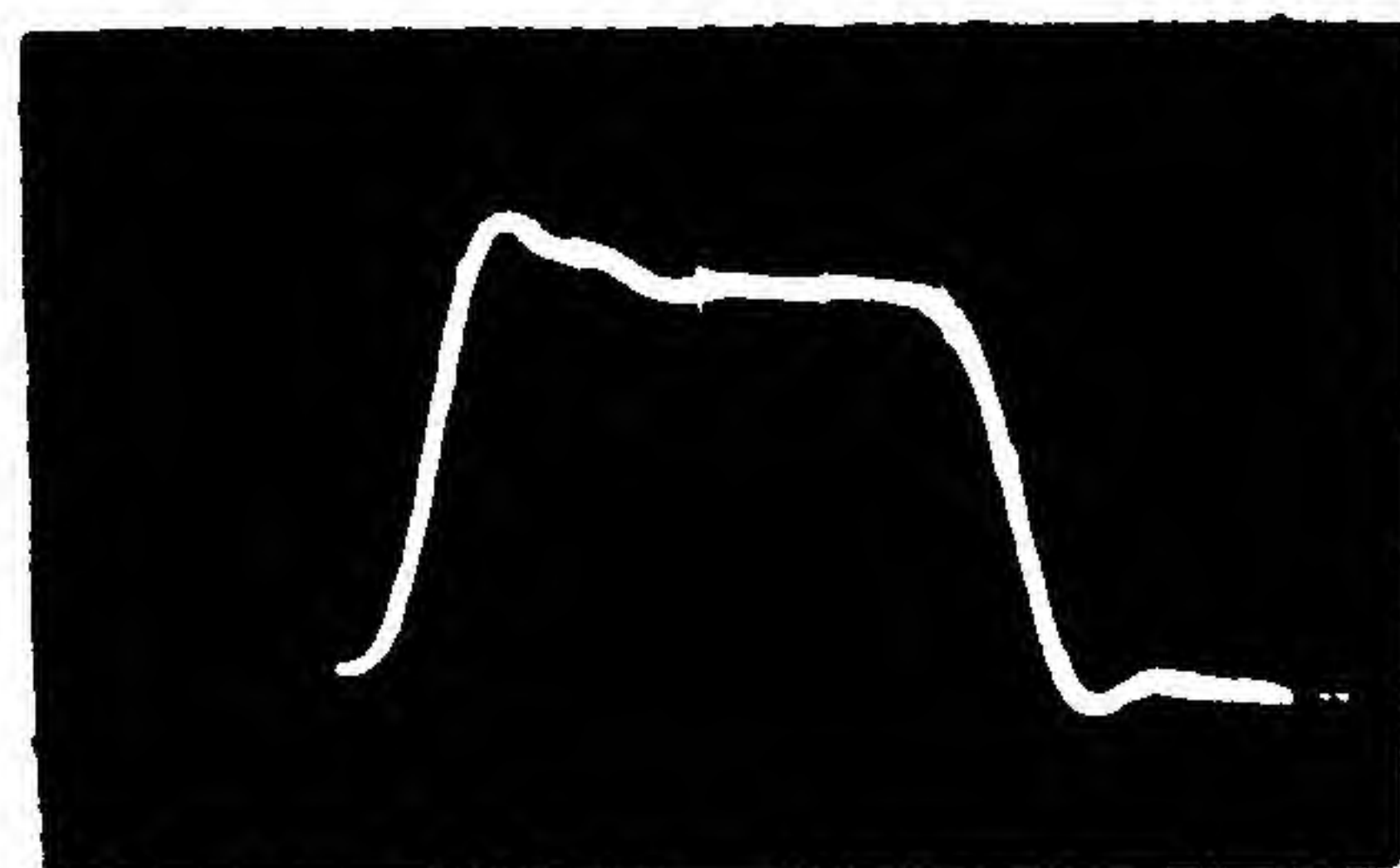
Current Output
(Pin B)

Sensitivity: 5 ma/cm
Sweep: 20 ns/cm

Figure 8-14 Line driver Circuits

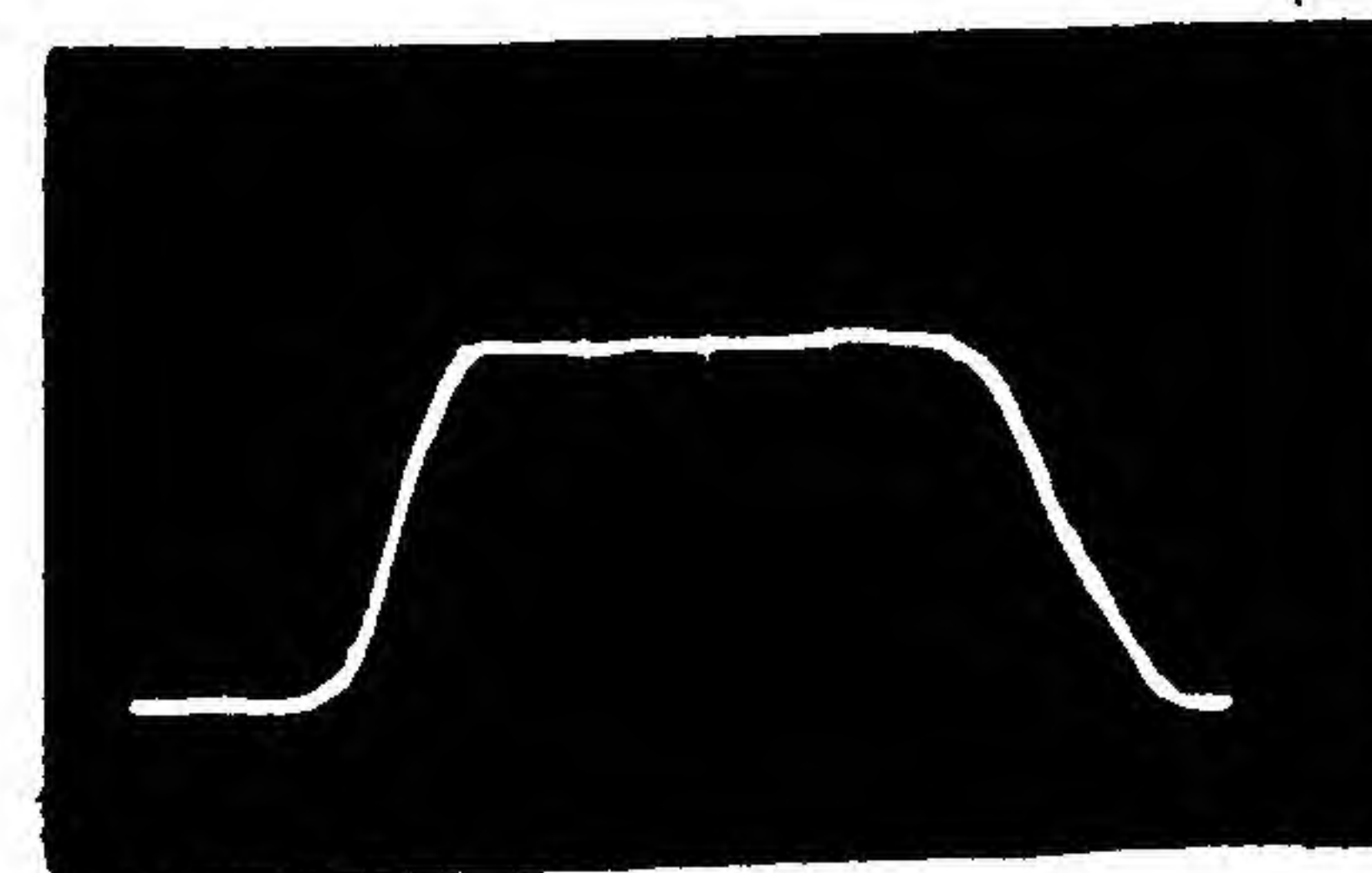


Block Diagram



Current Input
(Pin A)

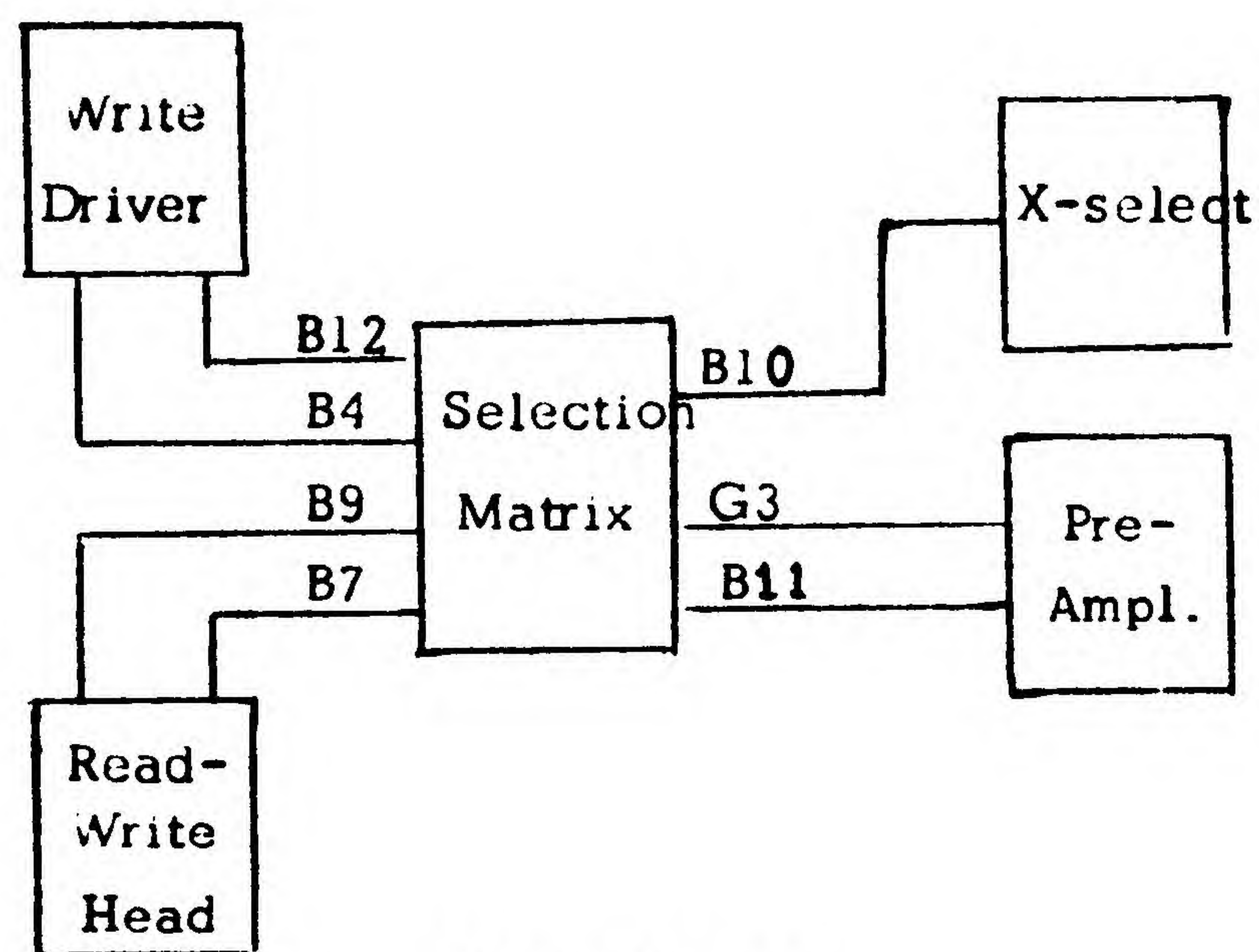
Sensitivity: 2 ma/cm
Sweep: 20 ns/cm



Voltage Output
(Pin B)

Sensitivity: 2 v/cm
Sweep: 20 ns/cm

Figure 8-15 Line Terminator Circuits



Block Diagram

Figure 8-16 Selection Matrix Circuits

X-Select

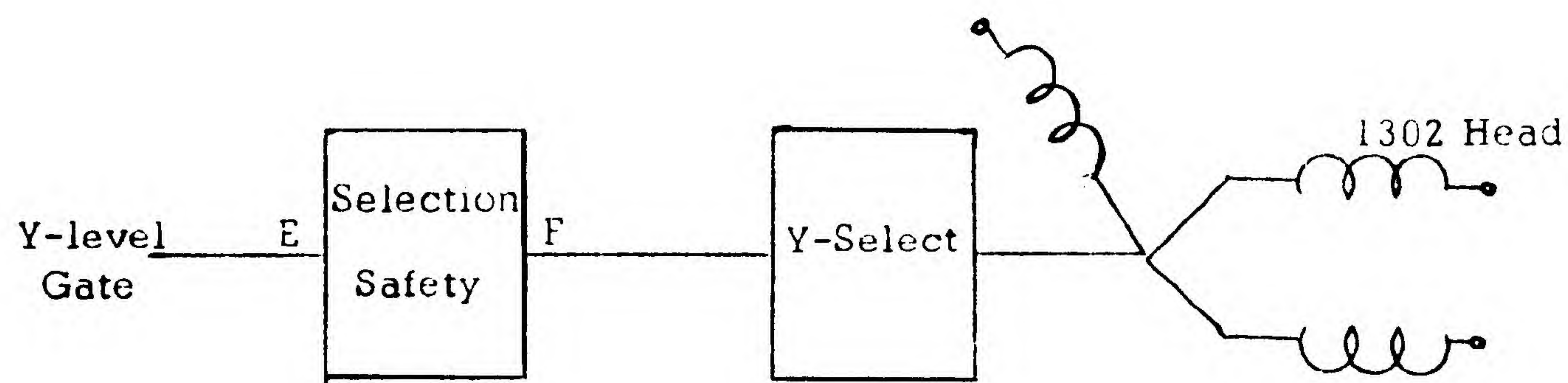
The X select provides a gate to connect a selected head electrically to read amplifiers.

There are four X-select zones in the matrix. The input to the X select is an S level gate. When either one of the input Pins G, E, H, or F is at -S level, there will be a corresponding output at Pin C, B, D, or A of -12v which forward bias as the diodes in the selection matrix. When one X-select zone is selected, the input gate to the other three zones is at an up level and results in an output of +30v which is the "not-selected" level for the matrix.

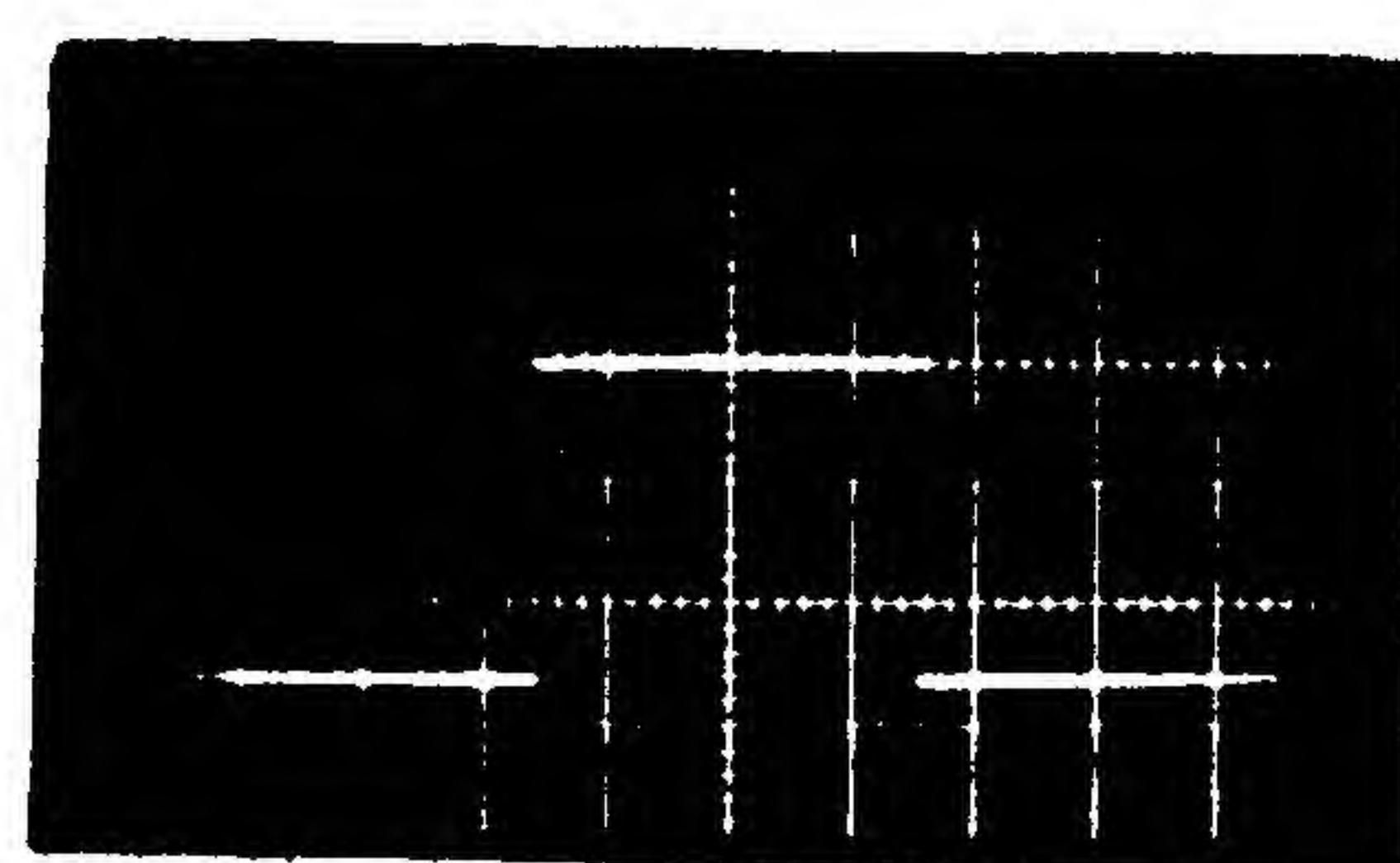
Pre-Amp Select

The pre-amp select circuit gates the pre-amplifiers with module zero or module one, whichever is selected.

The input to Pin D is driven by a loaded S level logic card. When Pin D goes to a -S level, the output at Pin E is -12 volts. During a non-select condition, the output is at 0v.

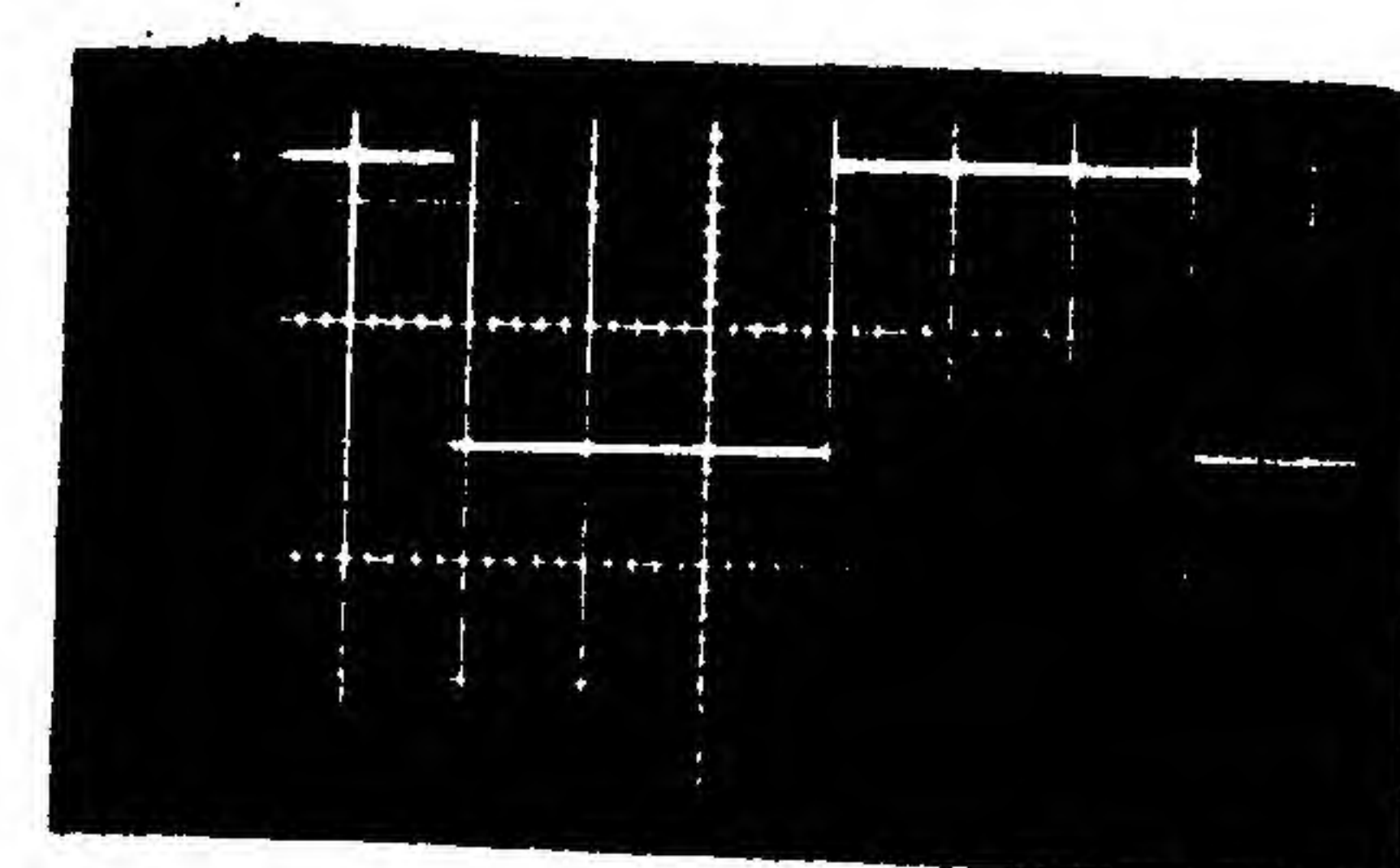


Block Diagram



Input Gate (Pin E)

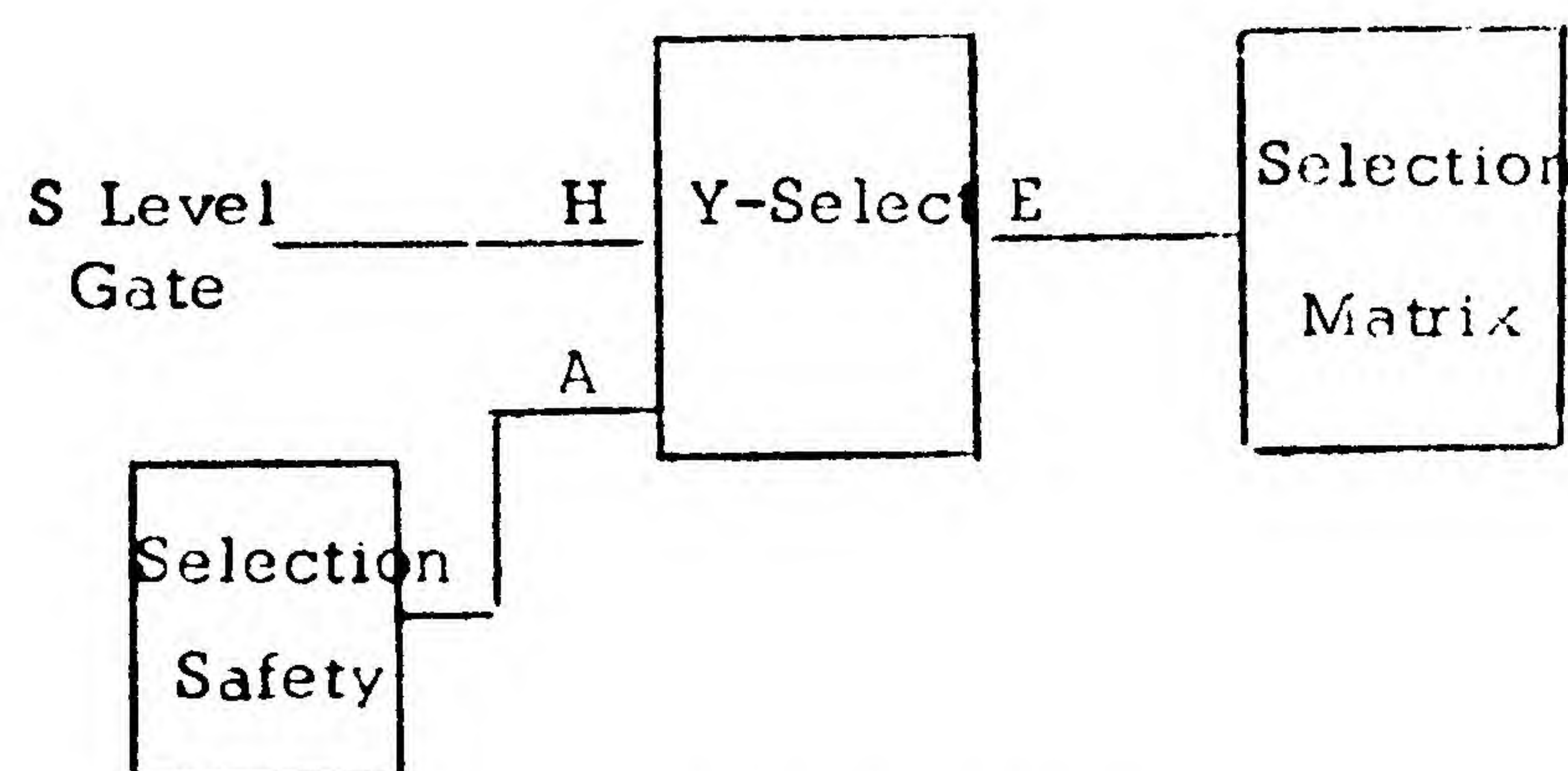
Sensitivity: 2 v/cm
Sweep: 10 m sec./cm



Output (Pin F)

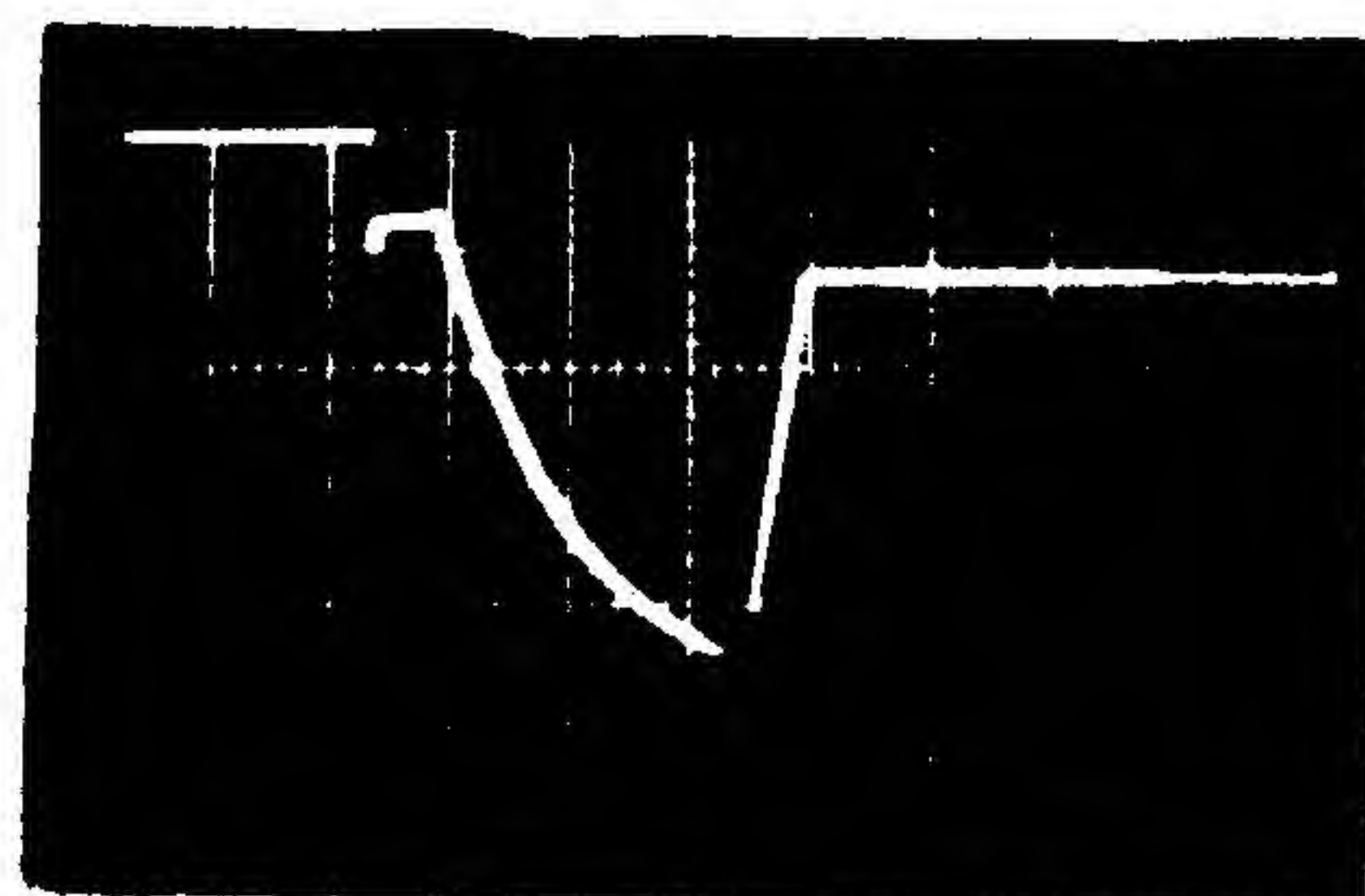
Sensitivity: 5 v/cm
Sweep: 10 m sec./cm

Figure 8-17 Selection Safety Circuits



Block Diagram

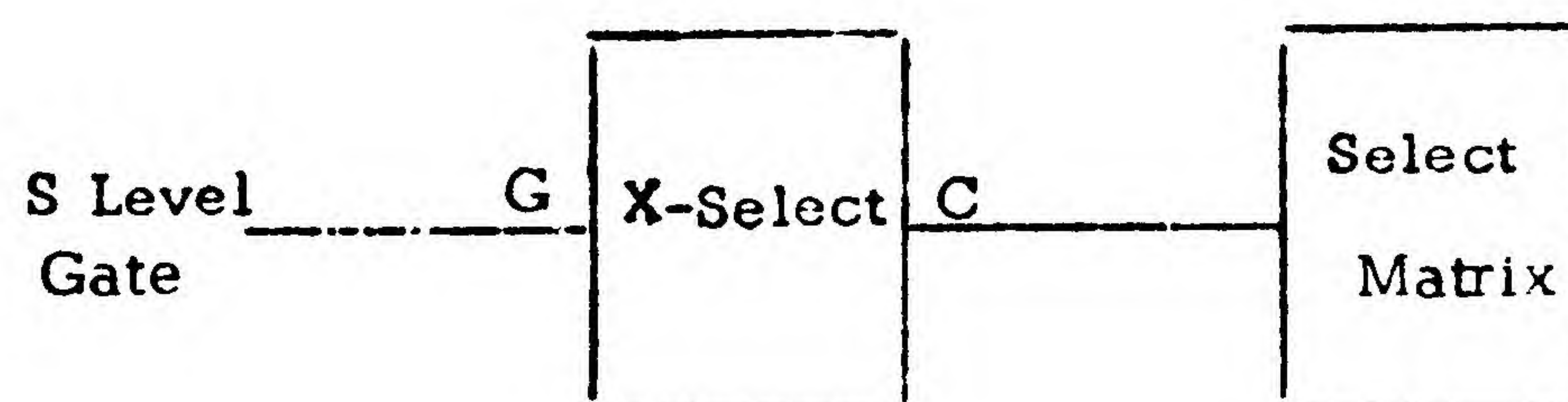
+12v
0v
-36v



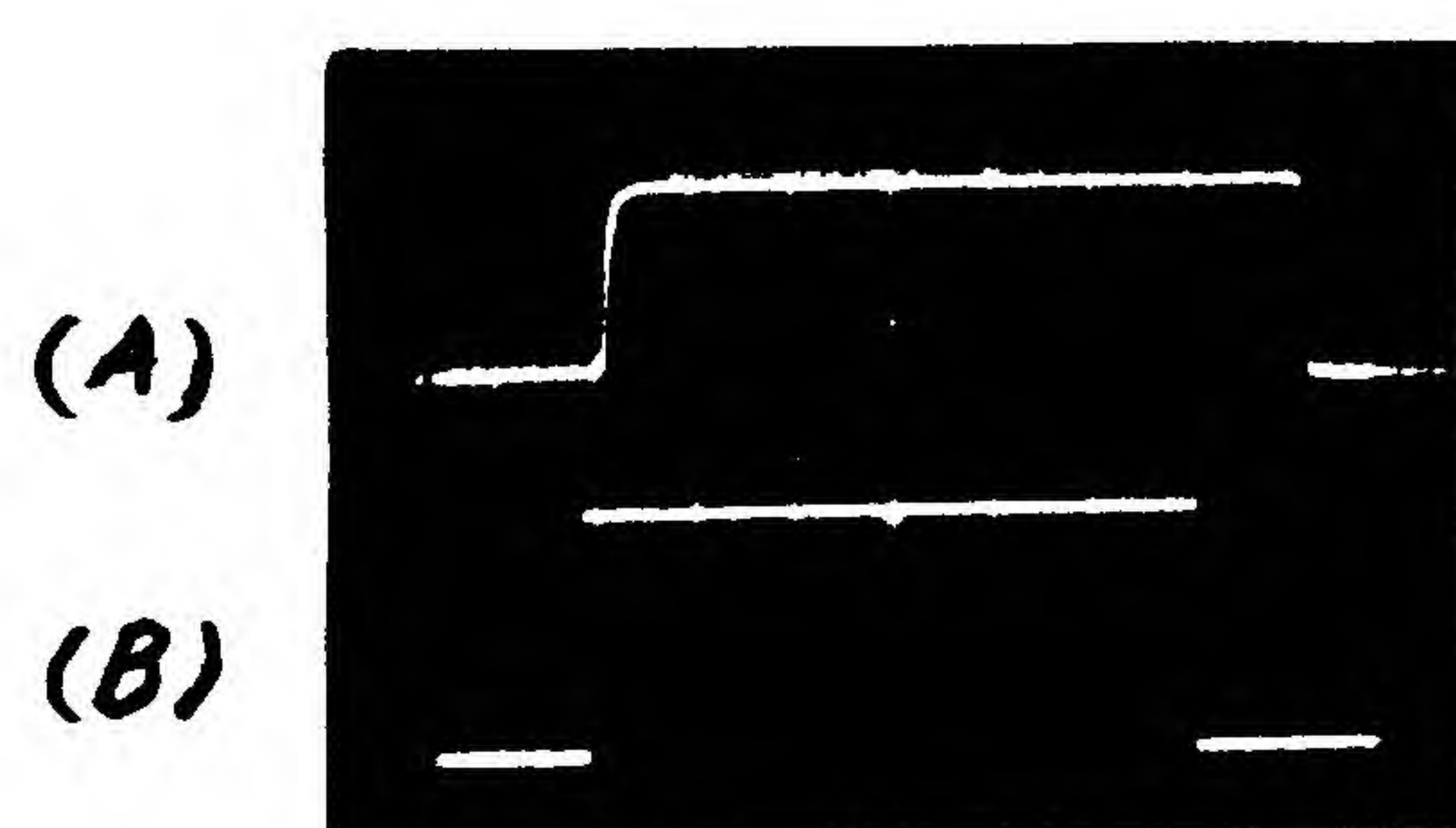
Y-Select Output

Sensitivity: 10 v/cm
Sweep: 20 μ sec./cm

Figure 8-18 Y Select Circuits



Block Diagram

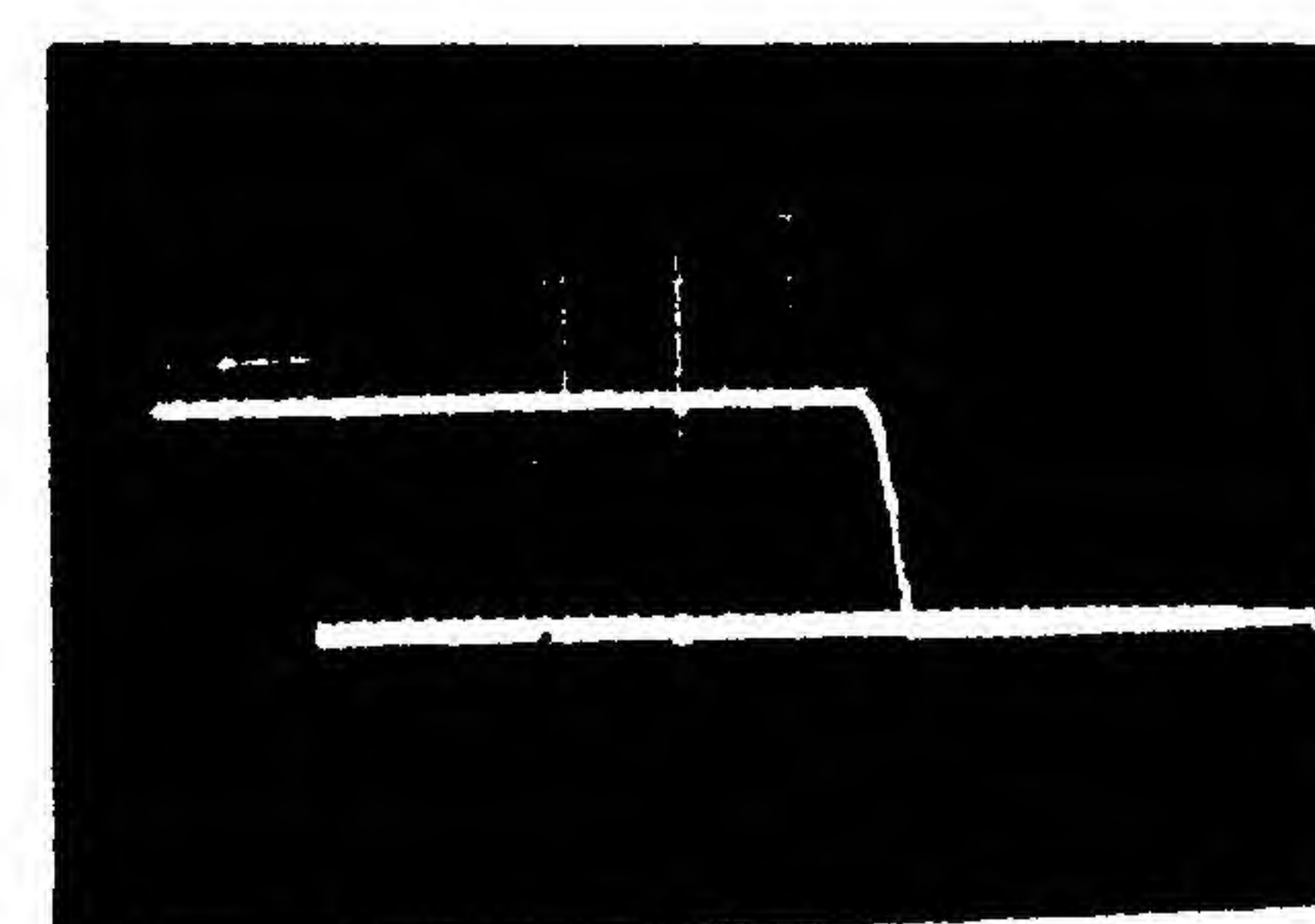


(A) X-Select Output
(Pin C)

Sensitivity: 20 v/cm
Sweep: 10 μ sec./cm

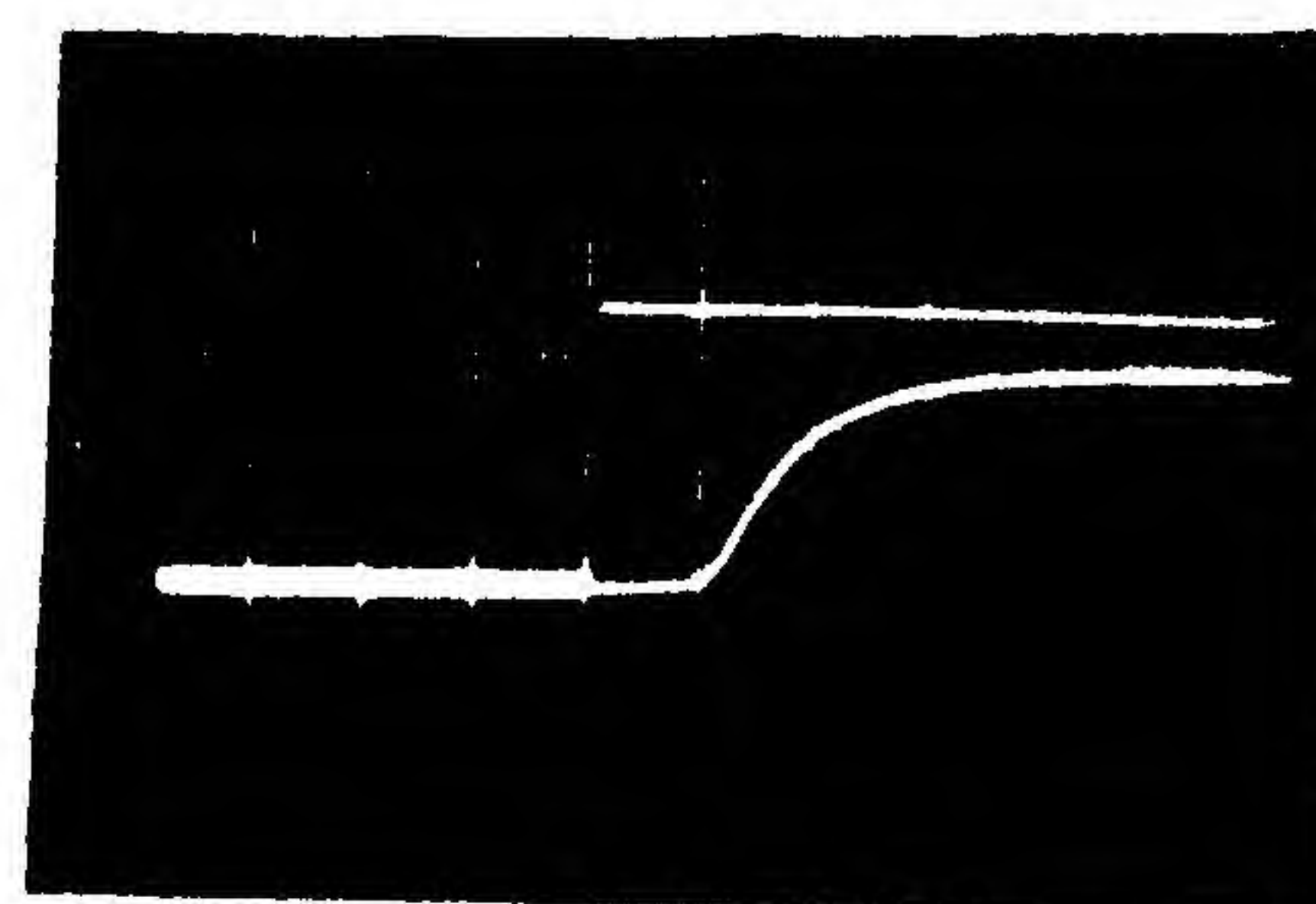
(B) Input Gate (Pin G)

Sensitivity: 2.5 v/cm
Sweep: 10 μ sec./cm



Turn on Delay
(Pins G and C)

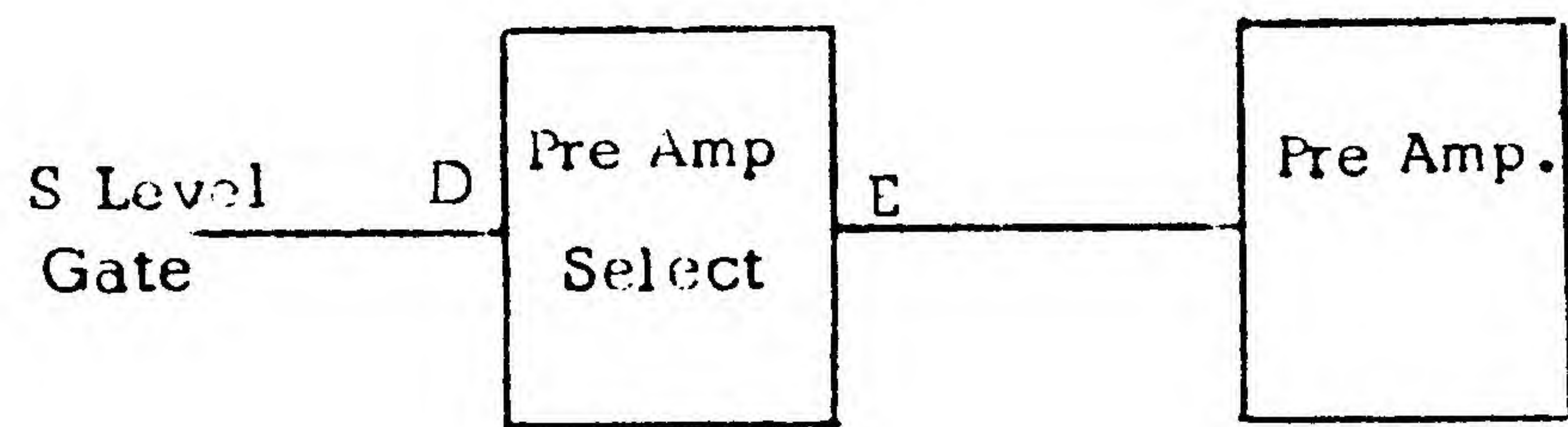
Sensitivity: Top Curve
20 v/cm
Bottom Curve
2.5 v/cm
Sweep: 2 μ sec./cm



Turn off Delay
(Pins G and C)

Sensitivity: 2.5 v/cm (top curve)
20 v/cm (bottom curve)
Sweep: 1 μ sec./cm

Figure 8-19 X Select Circuits



Block Diagram



Preamplifier Select

- (A) Linear Amplifier Out
Sensitivity: 1 volt/cm
Sweep: 20 μ sec./cm
- (B) Pre-amp. Select Gate (Pin A)
Sensitivity: 10 volt/cm
Sweep: 20 μ sec./cm

Figure 8-20 Pre-amplifier Select Circuits

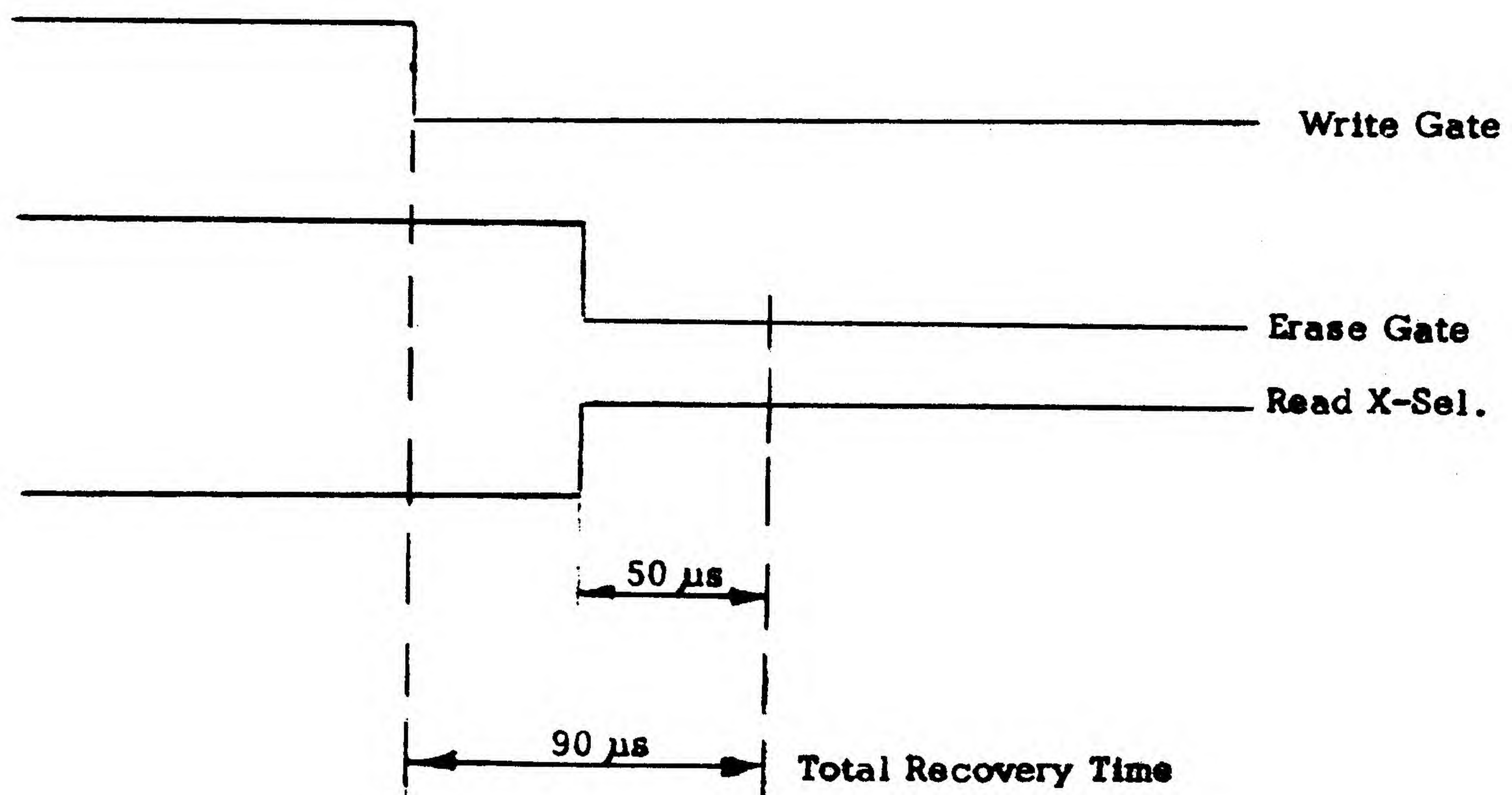


Figure 8-21 Write to Read Recovery Time

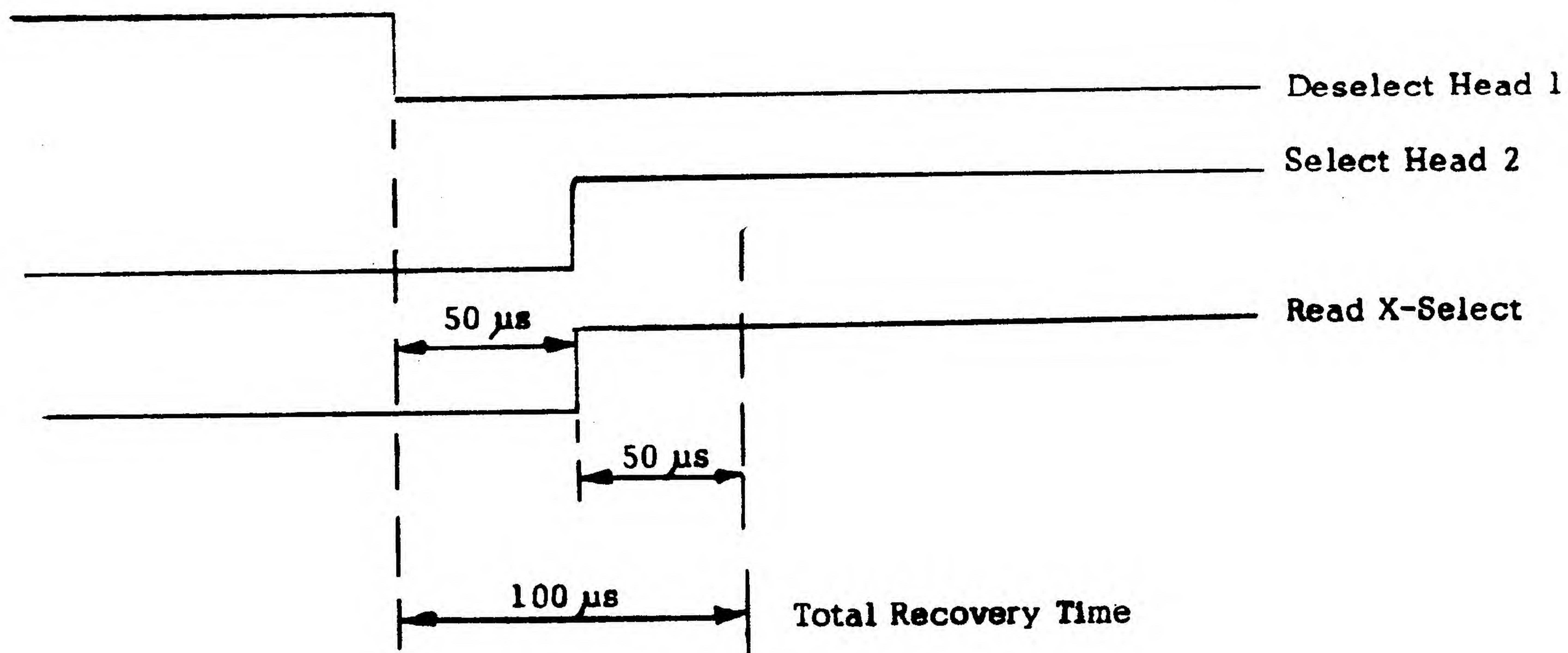


Figure 8-22 Head Switching Recovery Time

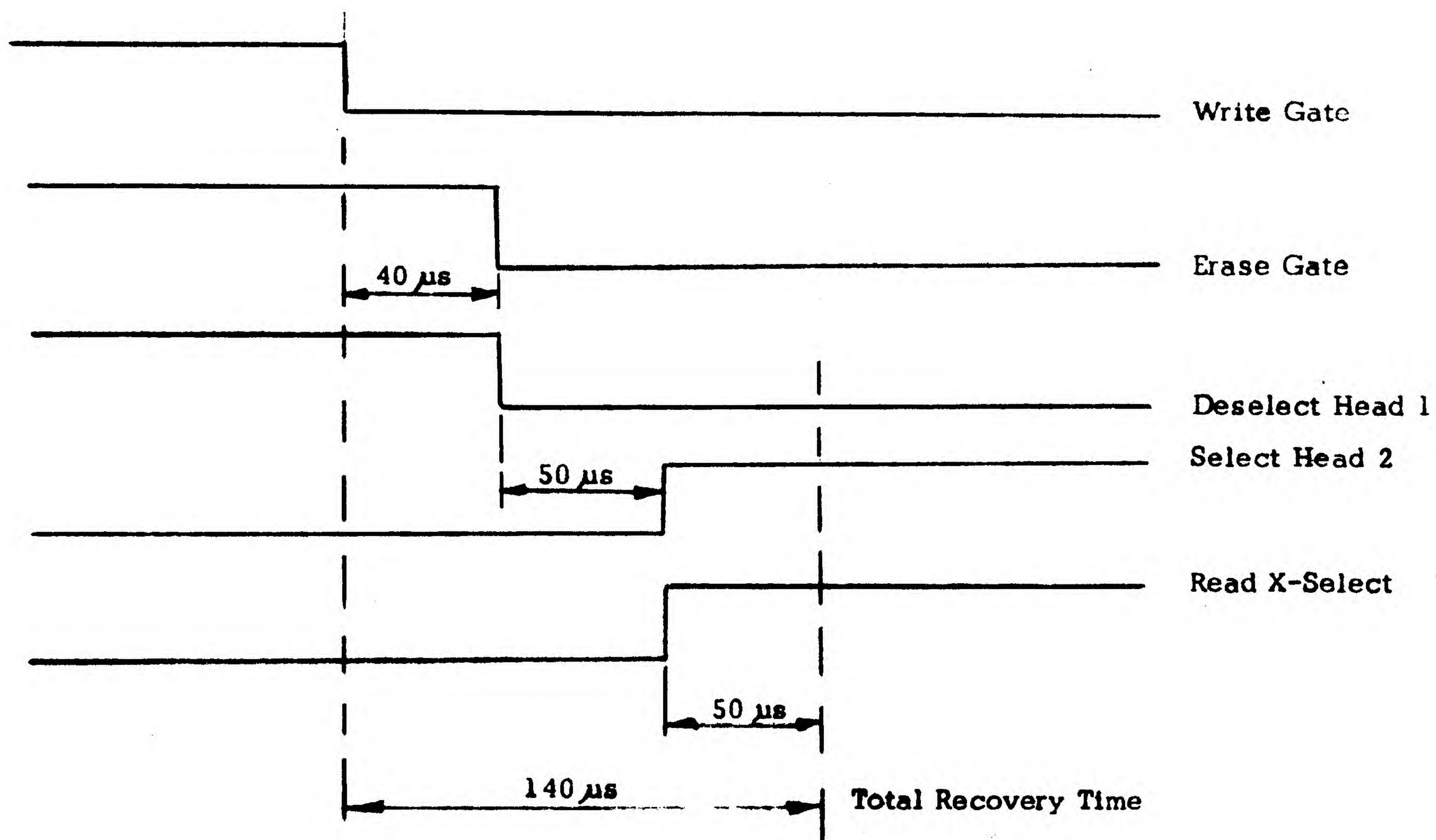


Figure 8-23 Write to Read Recovery Time(with Head Switching)

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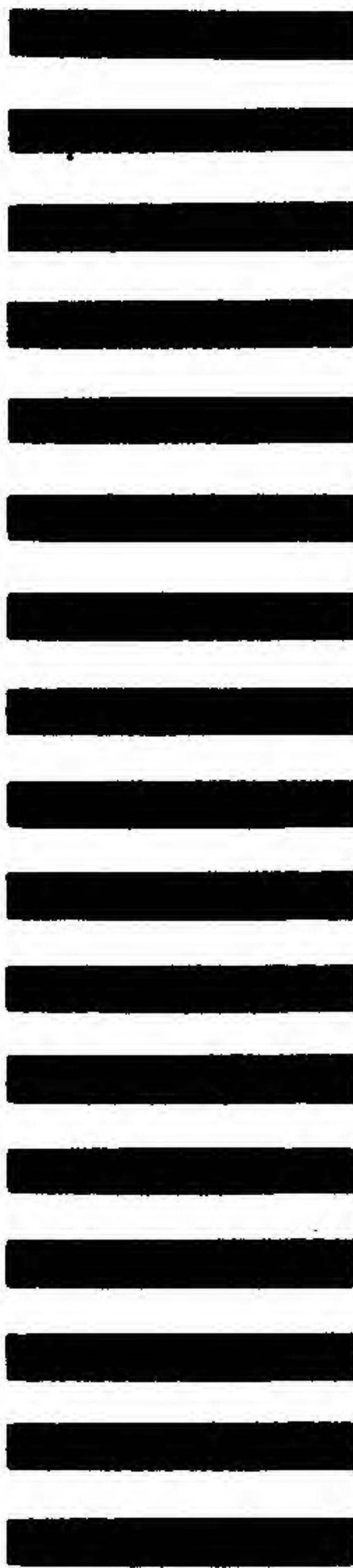
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